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Practical Aspects of Cross-Connection, Inter-Connection and Back-Flow Protection

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I. Scope of the Cross-Connection and Inter-Connection Problem

THE subject of cross-connections and inter-connections is somewhat broader than is ordinarily recognized. It deals not only with dual water supplies but with connections to a continuation of the water supply system containing used or altered water, and, which, in addition, may be directly or indirectly connected with lines conveying sewage. It involves various types of mechanical and plumbing fixtures as well as different uses to which water is put.

The terminology used in this paper takes into account the definition of terms which has been suggested in the tentative report of A.S.A. A40 Committee on Air-Gaps. The terms cross-connection, inter-connection and back-flow are defined as follows:

"*Cross-Connection:* A connection between a potable public water supply system and a secondary institutional or private (industrial, etc.) water supply system, the source of which is distinct from the public supply and from which source the water derived is distributed, under pressure, within the institution or industrial property. (Cross-connections to public water supply are recognized to be within the

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control of public health authorities. Reference is here made to the fact that public health authorities in some states forbid cross-connections even though the secondary supply may be considered potable and used for drinking water; in other states cross-connections with secondary drinking water supplies are permitted if an approved check-valve installation is made; and in some states cross-connections to emergency non-drinking water supplies are permitted if chlorination equipment is installed and operative.)

"*Inter-Connection:* Any connection between the potable water distributing pipes and the drainage or waste pipes of the plumbing system. (The term inter-connection as used in this paper has been extended to cover special industrial equipment so designed as to establish a potential connection between water and other process materials.)

"*Back-Flow:* The term back-flow as referred to herein means the flow of impure (non-potable or used) water, including sewage wastes or other contaminating material, into a pure (potable or non-used) water system. Such flow may be caused by gravity, vacuum or other pressure differential. The term back-siphonage has wide usage, describing one condition of back-flow due to the existence of a partial vacuum in the water distributing piping. Back-flow has also been used to describe a reverse flow condition in a piping system when normal service conditions are disturbed."

There is no question that a decrease in water-borne typhoid fever and obscure water-borne outbreaks of presumably unknown origin would result from a uniform and consistent program of cross-connection elimination and protection against back-flow. While many cities have specialized in eliminating certain types of connections, none have as yet secured complete protection and, accordingly, none can guarantee safe delivery of water either at the meter where jurisdiction generally terminates or at the taps where their moral obligation ends.

General progress in cross-connection and inter-connection elimination has been slow. It required over a score of years to teach various water, health, and fire insurance representatives that no direct connections should be made between the water supply and polluted dual supplies. It was not until the Chicago amebic dysentery outbreak in 1933 that a general move toward correction of plumbing hazards was given an impetus. The American Medical Association (1) thereafter recommended that faulty plumbing inter-connections along

with those of polluted dual supplies be eliminated. The American Water Works Association (2, 3), the American Society of Civil Engineers, and the American Public Health Association almost simultaneously adopted rigid requirements for water supply protection and plumbing hazard elimination for their convention hotels. A few cities subsequently amended their plumbing codes but it was not until 1938, and particularly in those cities where W.P.A. surveys were made, that persisting progress in the elimination of plumbing hazards was evident. Many sanitary engineers, at present becoming concerned with the cross-connection and inter-connection problem, are now agreeing with Johnson (3) that many unexplained cases of typhoid fever and other disturbances may be directly attributed to such faulty connections. In addition to health aspects, aesthetic considerations should prohibit the pumping of salt water and water chemically different from the usual supply into the domestic water system. Such practices may not only cause sickness from chemical poisoning, result in personal discomfiture, affect the suitability of water for industrial uses, but also cause loss of working time to innocent users.

Only a few cities appear interested in proper water piping provisions which are wholly neglected in most plumbing codes. There are probably not more than five cities which prohibit direct connections to steam boilers. One water department (4) for want of better protection, requires a single check valve on all 1-inch or larger services at the meter, but recognizes that a check does not give either entire protection to the district or to the owner of the premises. A number of cities have rather broad powers to control back-flow and back-siphonage, but there is no consistency as to the best procedures to obtain over-all results. New standards of water distribution security are needed because the coliform index, except where sewage connections are involved, is not a proper criterion to determine when back-flow or back-siphonage has occurred. Chaos exists in the matter of how protection may best be secured.

One of the chief reasons why the program of connection protection has been lagging is the great diversity of interested jurisdictions, such as water department superintendents, health department engineers, journeyman plumbers, plumbing inspectors, building inspectors, architects, mechanical engineers, firemen, and plumbing manufacturers. Ordinarily, water superintendents are little aware of how their normal operation of street main systems causes frequent

back-flow and back-siphonage conditions in private water piping systems and how it occasionally results in water backing through the meter into the street main and being delivered later to other consumers. Many superintendents feel overly secure that back-siphonage cannot occur because of the supposedly high and continuous pressure on all parts of the distribution and private water piping systems. As a matter of fact, the greatest vacuums to which plumbing fixtures are ever subjected are those caused by street main operation.

Plumbing divisions have been altogether too lax in formulating adequate water piping ordinances because, almost universally, plumbing codes deal only with house drains, vents and fixtures connected to the sewer system. Firemen do not hesitate to pump sewage, salt water, or any handy supply directly into fire hydrants or through siamese connections to private fire sprinkling systems which, in turn, may not have even a single check valve as a gesture to protect the domestic water supply. Except in a few instances, there is no control over the chemicals which may be added to the water supply lines subject to back-flow conditions. The uses to which water may be put and a determination of what constitutes abuses are but little regulated. Mechanical engineers too often connect boilers and hydraulic elevators directly to the water supply. Steam, on condensing, produces sudden vacuums second only to those possible by the draining of large street mains. Architects formerly designed house water piping systems so that all drinking water fixtures were supplied separately from tanks. In more recent years, and particularly where it has been desired to save money in water piping, there has been an almost complete change in policy, until now the use of water supply lines for any purpose whatsoever, even to the point of using a single pipe for simultaneous flow in both directions, has developed. This present laxity in cross-connection protection is not chargeable to any particular group. Many interests will be found to be involved, when the stage of restoring order is reached.

Manufacturers have in the past few years done much to overcome such plumbing defects as under-the-rim inlets; have developed vacuum breakers, top-inlet toilet bowls in place of side-spud inlets, and mechanical devices to prevent back-flow; have changed the combined inlet and outlets to bath tubs; have produced stable flush valves; and have shown an ever increasing willingness to co-operate in back-siphonage prevention. The expense of changing patterns

and redesigning fixtures, however, is large, and there should be uniformity among all interested jurisdictions before final decisions are made as to what constitutes proper protection. The time has arrived when water works superintendents, health officials, plumbers, inspectors, manufacturers, architects, mechanical engineers, and firemen should be educated jointly on the general problem of back-flow and back-siphonage so that each group can see the principles involved from the practical standpoint and so that delivery of safe and potable water can be guaranteed to all consumers. Only by unifying all jurisdictions which are involved with a single problem can a uniform and consistent procedure ultimately be determined.

The purposes of this paper include:

1. Development of a broader view of cross-connections and inter-connections
2. Determination of the inherent causes of back-flow and back-siphonage
3. Classification of all types of cross-connections and inter-connections
4. Summation of the best information gleaned from over 150 questionnaires submitted by state health departments and by all of the largest cities in the United States, in the matter of appropriate laws, codes, ordinances, and regulations relating to cross-connection and inter-connection protection
5. Comparison of various mechanical devices and plans of cross-connection and inter-connection protection
6. Recommendation of a consistent program covering the entire field of cross-connections and inter-connections, including curtailment of causes creating back-flow and back-siphonage, prohibition of most cross-connections to sewers and polluted sources, and assigning specifications of mechanical methods of protection.

II. A Broader View of Cross-Connections and Inter-Connections

Although inter-connection between a water and a nursery line, carrying fertilizing solutions, was recognized as dangerous in 1913 (5), it is generally true that prior to 1927 dangerous connections were considered to include only those involving dual water supplies. Groeniger (6), in 1927, predicted that faulty plumbing would cause subsequent epidemics and it was his work which opened up a new field. Connelly (7), in 1928, pointed out the dangers of inter-con-

nections in plumbing arrangements at hospitals. Morris (8), in 1929, expanded the idea of inter-connections to include used or treated waters and cited instances where lime-treated water for boilers, sewage through a sewage pump priming line, and compressed air from a garage backed up into water mains. Except for sporadic efforts, no general progress was made in correlating various types of connections and determining uniform corrective measures. In 1930, the Bureau of Water Works and Supply of the City of Los Angeles added steam boilers, fire services, and sewer inter-connections to the growing conception of hazardous connections. In 1931, the Los Angeles Plumbing Division set up a test laboratory and experimented with the Venturi tube type of vacuum breaker. Following the Chicago amebic dysentery outbreak in 1933, Chicago, St. Louis, and San Francisco immediately took active steps to eliminate plumbing hazards. Fletcher (9) stated in 1937: "Quasi-public supply may be the water-supply used water. Direct sewer connections should not be tolerated and cross-connections [inter-connections] through plumbing fixtures are important." The American Public Health Association Year Book for 1938 terms plumbing fixtures as "cross-connections." Gorman (10), in 1939, and subsequently, stressed the point that used and stored water inter-connections in buildings are inimical to public health.

Inter-connections may render the domestic supply bacteriologically unsafe, chemically poisonous, and aesthetically unfit for drinking because of temperature change, chemical additions, and inclusion of corrosion products. Substances other than water may enter the domestic water piping system through inter-connections. The correction of such connections involves physical separations in one instance and protective mechanical devices in another.

Considerable thought has been given to differentiating between direct cross-connections and indirect or so-called inter-connections. The State Plumbing Code of New Hampshire classes cross-connections as "a connection in the plumbing system in which an unapproved secondary or emergency supply is connected directly by pipes or valves with a public water supply." An inter-connection is defined as "a water supply connection to a fixture or to a sewer, drainage, soil, or waste pipe, so installed that the contents of the fixture or of the drain may enter the water supply line."[1] The City of

[1] Rules and Regulations Relating to Plumbing—I (e) and (f), 1937, New Hampshire State Board of Health.

Bismarck, N. D., defines a cross-connection as "a direct or indirect connection by means of pipes, tanks, receptacles, equipment or plumbing fixtures, containing sewage, waste water or any other material foreign to the city water supply through which such material might be siphoned, forced, drained or otherwise introduced into the city water system."[2] The City of El Paso, Tex., includes in its plumbing ordinance the following definition: "Cross-connection shall mean any installation of hot and/or cold water piping, or any portion thereof, which is so arranged, connected and/or installed that it will be possible for used, unclean, polluted or contaminated water, mixtures and/or substances to enter . . . be drawn . . . or be introduced, forced or drawn . . . through . . . movable connections, etc."[3] The City of Memphis, Tenn.,[4] regards any private water supply served for domestic purposes, whether cross-connected with the public supply or not, and where it may be used in connection "with the manufacture or handling of ice, foods, or drinks . . ." as a quasi-public water supply.

A broader view of connections can, therefore, be stated to be any physical arrangement with domestic hot- or cold-water piping whereby its water may be rendered bacteriologically unsafe, chemically poisonous, or aesthetically objectionable. The medium conveyed by back-flow may be sewage, used or altered water, a dual water supply, or liquids entirely foreign to water. The physical arrangements may include valves, overflows, drains, direct connections, check valves, extensions of the domestic water system, devices operated by water and plumbing fixture inter-connections. Forces creating back-flow may be vacuums, or pressures created by pumps, drops in pressure, or independent pressure or vacuum sources.

III. Factors Involved in Connection Protection

A. Causes of Back-Flow and Back-Siphonage

The same fundamental factors of hydraulics, of operation of water and sewage lines, and of the behavior of steam and sewer gases apply equally to the water distribution system and private water piping

[2] Ordinance No. 596, Section 18-311—Cross-Connections Prohibited; City of Bismarck, N. D.

[3] Plumbing Ordinance; approved August 10, 1939; Section b (2); City of El Paso, Tex.

[4] Ordinance—Plumbing; second reading March 19, 1940; City of Memphis, Tenn.

system on the one hand and to the street sewer and house drains on the other. Protection afforded should harmonize these factors and be consistent. The starting point in the problem is an understanding of what happens when water supply pressure falls or becomes negative; when either excess pressure or a vacuum is created on the user's property from pumps, tanks, gases, boilers, or sewers; when faultily constructed plumbing fixtures have been selected; or when proper fixtures are incorrectly installed.

Back-flow is caused by a lower water pressure differential in some part of water supply piping, by direct pump suctions on the supply side, by excessive use of water in undersized lines, or by an increase of pressure on the property side. Air being admitted to prevent vacuum formation may act as an aspirator and permit material in spray form to enter the supply lines through sewer-connected fixtures. This factor is an important one which requires serious consideration.

1. Pressure Drops

Theoretically, all water lines should have a uniform pressure at all times, regardless of usage requirements. This ideal cannot be attained because: (1) varying rates of use cause different pressure drops; (2) sudden flushing from fire hydrants and pumping from street mains by fire engines also produce wide fluctuations in delivery pressure; (3) occasionally water lines are accidentally drained due to breaks in mains, during street repairs, caused by pavement smashers, steam rollers, pipe structural failures, enlargement of leaks, and by pipe failures resulting from improper grounding of stray electrical currents; and (4) mains are subject to deliberate draining for repairs, tests, extensions, prevention of freezing, and, occasionally, loss of pressure may result from incorrect manipulation of street main valves by crews unfamiliar with gate valve locations. Gradual long time lowering of normal pressure may be caused by a decrease of main capacity as a result of corrosion, tuberculation, or chemical deposits. Higher pressures must be maintained in areas of uneven topography, and this, in turn, aggravates pressure drops. Street main pressure drops have a tremendous effect on private water piping systems because the private systems are higher than the street mains and take the full shock of pressure variations. When the upper parts of buildings are in zones of zero pressure, any storage in the piping system may be utilized directly to fill street mains.

Further drops in pressure occur in the private water piping systems due to loss-of-head in meters, strainers and pressure regulators, and due to yard sprinkling use, pyramiding of simultaneous operation of several water fixtures, undersized piping, and increased use of water. Normal residences require a $\frac{3}{4}$-inch meter as the minimum size to avoid twice the drop in pressure from pipe and fixture losses that results when $\frac{5}{8}$-inch meters are installed (11). Too many homes have $\frac{1}{2}$- and $\frac{5}{8}$-inch meters, and the meters and pipes in apartment houses equipped with flush valves are invariably undersized. A great hazard in pressure losses in private piping systems could be eliminated by proper water piping codes controlling the size of meter and pipe sizes to various fixtures.

There is also frequent draining of private lines for repair, for prevention of freezing or for convenience, in all of which cases the water piping system is subjected to serious strain. Water systems are particularly defective if water is made to flow both ways to fixtures subject to sudden usage. There is a continuous substitution of water fixtures which require greater quantities of water. Commercial and industrial plants designed for one scheme of operation become antiquated when new equipment is installed and may even become totally inadequate when adapted to an entirely new process by new owners. Pressure drops are also caused by pressure waves, surges, and water hammer phenomena, although the extent of actual backflow is limited.

2. Vacuum Conditions

Whenever the pressure in the water supply lines drops to a point less than atmospheric pressure, vacuums are created. It requires only 34 ft. of vertical water line emptying, with no ingress of air, to produce a theoretically perfect vacuum. In tall buildings and in hilly sections, high vacuums may occur suddenly and may be of continued duration in inverse ratio to the amount of air leakage through faulty plumbing fixtures and to leaky devices protected with vacuum breakers. As the vacuum tends to become satisfied, there is still further draining of water which tends to restore a vacuum again. A vertical $\frac{1}{2}$-inch line, 34 ft. high, compared with a 24-inch line parallel to it, when simultaneously drained at the bottom, requires $\frac{1}{2300}$ the amount of air for similar periods of free draining. It is impossible to admit enough air through one fixture to satisfy the vacuums formed in large lines, and this must be taken into

consideration in obtaining protection against back-siphonage (12). Under these conditions it is possible for water in private piping systems to pass through the meter into street mains and, if not completely drained and subsequently flushed out of the system, such water will return to additional consumers when pressure is again restored.

A partial vacuum is further dangerous because, as air rushes in through various fixtures, it creates an aspirator effect on all lower points of water use in the same fixtures, so that foreign material contained in the fixtures may be lifted above the actual water level in the fixture itself and thus into the water system. A good example of this phenomenon is an unstable flush valve connected to a siphon jet bowl but not protected with a vacuum breaker. Under vacuum conditions the valve opens and the full force of the vacuum (in cubic feet per minute, determined by the rate at which the line is being emptied) starts taking air in through the rim-outlets of the toilet bowl. This air, on passing the jet channel, acts as an ejector and lifts water from the bowl, breaking it into a spray which then enters the private water piping system. The material, in spray form, may travel upwards for indefinite distances so long as air is being taken into the water system.

Vacuums are also caused by condensation of steam. If the water line to a boiler is open when there is steam pressure in excess of the water supply pressure, or if a water heater overheats so that steam replaces water in the distribution system, the mere expansion of the volume of steam from the same amount of water represented by the steam causes a back-flow condition and pushes the water and steam back into the street mains which serve other consumers. When the steam, which has passed into the water pipes as well as in the boiler itself, condenses, however, there is an immediate contraction of equal magnitude, even though the water pressure is still normal in the street mains, and the rapidity of this condensation may create a vacuum of serious intensity in the private water piping system.

3. Excess Private Piping Pressure

Pumps, whether used on supply lines to increase pressure to operate filters or softeners, or to maintain separate systems for ice-cooled water, hot water systems, air-conditioning equipment, cooling water for refrigeration, or for various commercial or industrial uses, may

cause back-flow into the water supply lines if physical connections exist, if check valves leak, or if manual valves are incorrectly operated. Often, pumps are directly connected to water supply mains in order to feed storage tanks so that uniform pressure may be maintained at all times. Experience shows that where such installations are made, even though protected with check valves, there is an alternate period of reversal following each pumping. Water supply lines have been found directly connected to Foamite tanks for fire protection, to glycerine tanks under high pressure at soap plants, to salt water fire protection lines, and to oil lines with oil-gas pressure on the private side. This practice, in all instances, creates a pressure higher on the property side than exists in the water supply mains. Fire engines, pumping directly into street mains from fire hydrants or private fire sprinkling systems, or from salt water, sewage, storm water, or water from any available source, operate generally at a higher pressure than the existing public water supply pressure. What is most significant is that most fire chiefs feel that their right to combat a conflagration is greater than the need for protection of water supply lines against pollution. So far as the writer knows, there is no legislation, ordinance or water department regulation anywhere prohibiting this abuse. Steam boilers and hot water systems constitute one of the most serious causes of excess pressure on the property side of water supply connections. This is evidenced by the large number of damaged rubber discs used in meters. Many water departments are put to great annual expense to repair these meters, and endeavor to collect from consumers responsible for the damage. The danger from such back-flow into the water supply system is two-fold; serious consequences may result from the escape of steam rather than water when values are opened, and because the chemicals added to many hot water systems are dangerous.

4. Connections With Fixtures Actuated by Pressure of Other Sources

The number of water-using devices connected with other equipment under pressure is increasing. One instance is that of a carbonator fed directly with water and inter-connected with a carbon dioxide tank having 1200 lb. per sq.in. pressure, which uses a reducing valve set just a few pounds over normal water pressure; another is that of an automobile shampoo fixture using water and compressed air, with the latter at a higher air pressure than water pressure.

Pumps have been designed to add fertilizers to water supply under pressure in irrigating orchards. These devices, with an individual source of pressure, when connected to water supply lines, have, in the writer's experience, actually caused back-flow into water supply lines. Excess pressure may be obtained also from tanks or lines carrying water to which have been added chemicals which have so changed the specific gravity of the water that the material, when connected to water supply lines, sets up a natural circulating condition creating back-flow.

5. Sewer Connections

The aim of sewerage works practice and of plumbing practice is to get rid of sewage and waste as rapidly as possible with gravity lines sufficient in size to prevent stoppages and with ventilation to prevent the sewer gases from blowing through traps into open plumbing fixtures. This ideal is rarely met, as sewage may back up, under flood conditions, from excessive flow use, or because of stoppages, until it overflows the top of the lowest manhole affected. House plumbing systems, once they are lower than street level, are subject to backing up from street sewers and are always subject to backing up from local stoppages. Where basements are constructed below sewer level, sewage pumps and force mains, which necessitate pressure lines carrying sewage on private property, are required. The fact that so many back-flow valves are installed to prevent sewage spilling into basements shows that sewage does, under certain conditions, actually and frequently back up. A practice of using waste lines for all fixtures in discharging fecal matter and to allow an air gap where such lines discharge into sumps from which the material is pumped to sewers, has been developed. Sewage cannot back up into such fixtures and, accordingly, the type of protection for them is limited to changes occurring on the water supply passing such fixtures. Other connections made directly to sewers are subject not only to sewage pressure but also to attack from gases. These gases may pass leaking valves or fixtures through uphill lines even though water is passing in the opposite direction.

Connections to sewage force mains, such as priming lines and discharge lines from filter backwash operations, are subject to the full sewage head under which the sewage pumps operate.

Leaking sewer lines or points where sewage overflows when located over water storage tanks or ice-making operations constitute a type

of connection somewhat out of the line covered by this paper, but which is nevertheless important.

6. Improper Types of Water Use

Numerous instances have been found where water used for drinking purposes is first used to cool water jackets for refrigeration units and gas engines. Likewise, instances where cooling tower water has been used for condenser cooling before delivery to water users for domestic purposes, have been discovered. All such practices are inimical to public health and should be abolished.

There is no general standard scheme of colors for painting water-waste vent or sewer lines, so that the owner or architect or plumber, during alterations, may be prevented from unintentionally making direct connections.

There are also many cases where owners concoct schemes in an attempt to minimize water bills. For instance, a number like to use well supplies in the daytime and city water for fire protection at night. Others, who prefer the city water for commercial purposes have been known to pump a hard-water well supply back through the water meter at night so that the total water bill would be normal. Such conditions as these constitute a serious type of cross-connection.

7. Characteristics of Water and Sewage

It should be borne in mind that water may contain corrosive constituents, scale, fish, sand, sludge, cement clinkers, waste lead and other substances, according to circumstances. In view of this fact, check valves cannot be expected to seat with positive surety under all conditions, so the design of all mechanical devices must take such factors into account.

Sewage contains an even greater variety and quantity of substances which interfere with the use of mechanical devices and is more corrosive than water.

It is to be noted that no distinction has been made between dual water supplies and used water supplies. Back-flow and back-siphonage conditions if not properly corrected may admit air, sewage, waste, or secondary supplies which may render the water supply bacteriologically unsafe, chemically impotable, unsuitable insofar as temperature is concerned and aesthetically undesirable due to many foreign substances which could gain access to the supply from present existing inter-connections.

B. Necessity for Use of Some Types of Connections

Connections of many types have come to stay. Dual supplies are essential for fire protection, and may be more suitable for commercial or industrial purposes or afford greater adequacy of supply and economy of operation. In many instances, dual water supplies are valuable to augment limited municipal supplies, and, where safe sources are used or the water is from the same underground strata, their use is justified. Plumbing fixtures are, in effect, inter-connections and their use has been so accepted that to discontinue them would work an extreme hardship. Polluted dual water supplies are considered dangerous. Even more so are most plumbing fixtures because they are directly connected to sewers carrying fecal matter. While there has been a tendency in some parts of the country to prohibit mechanical devices in the protection against dangerous interconnections, such a policy cannot be continued in the plumbing field. Hence, it is necessary to accept mechanical devices as the logical method of protecting water supply lines through plumbing fixtures and to extend the method to the prevention of back-flow and backsiphonage through other types of water services. Direct connections to sewers must include, for the time being, the use of air gaps until satisfactory mechanical equivalents for air gaps have been developed. Safe dual supplies, on the other hand, may need no protection. Where the cross-connection is between the main supply and the used or altered domestic water supply, and, in turn, is inter-connected to waste lines, having air gaps, before entering the main house plumbing system, some mechanical protection appears desirable, but it need not be as severe. Hence, it is clearly necessary to modify plumbing practice and to permit certain types of protection for water lines serving fixtures which are sewer-connected and to permit less stringent types of protection when consistent with the danger involved.

C. Need for Consistency in Regulation

Considerable research has been undertaken recently by the universities, master plumbers associations, and manufacturers of plumbing equipment, such as the co-operation sponsored by the National Association of Master Plumbers with F. M. Dawson of Iowa State College (13), and by the Massachusetts State Association of Master Plumbers with T. R. Camp of the Massachusetts Institute of Technology (14), as well as work done at the University of Wisconsin

(15), and by the Kentucky Survey and Research Committee at Louisville (14). The State Board of Health of New Hampshire has issued a 69-page bulletin with 44 illustrations, explaining cross-connections. Other states and cities are doing excellent educational work. New Bedford, Mass., has conducted vocational schools on cross-connections. Undoubtedly much is being accomplished in eliminating some of the grosser instances of plumbing defects and in determining methods of testing back-siphonage and back-flow through plumbing fixtures.

Many cities in the past ten years have conducted extensive surveys on back-siphonage and cross-connections with dual supplies. In 1933, San Francisco made a card survey of 221 dual supplies (4). St. Louis, in 1934, found 3,025 plumbing defects at four hotels, 1,197 at hospitals, 210 at milk plants, and 187 at 38 swimming pools (3). The East Bay Municipal Utility District at Oakland, Calif., found 408 dual supplies, mostly private wells cross-connected with the public supply (16). Memphis, in 1936, reported 143 quasi-public supplies under control (9). Remarkable surveys have been made at New York City (17) and Detroit (17) indicating that 70 per cent of the plumbing was unsafe. A survey of 906 federal buildings by the United States Public Health Service disclosed that 68.5 per cent of 24,664 plumbing fixtures were faulty (17).

Yet, while this excellent program is going on, a glance at newspapers and periodicals during the past two years shows that cross-connections are increasing in notoriety.

The *Press Telegram* at Baton Rouge, La., on March 25, 1940, reported that a handyman connected a gas line to a water line causing gas to enter the water distribution system. The mistake resulted in three accidents: one where a man watering a lawn had the gas issuing from the hose break into flame; another where a two-story house was burned; and a third where a man flushing a toilet was blown out of the bathroom by an explosion.

The United Press on January 13, 1940, reported that, in Joliet, Ill., during a period when the city water pressure was low, private water supplies from two breweries and two soft drink bottling works backed up their wares into the city water system. Complaints concerning "pollution," varying from beer to strawberry soda, were received.

The *Los Angeles Times*, on June 4, 1939, reported that at Fullerton, Calif., an oil-well operator had connected with the city water main

to kill gas pressure in an oil well under construction, and that gas and oil backed into the water system, including a 75,000-gallon elevated storage tank. Over 300,000 gallons of water were used in flushing oil out of the system.

The *Los Angeles Times* of March 25, 1939, reported that over 40 cases of poliomyelitis, contracted at the General Hospital, were caused by faulty plumbing fixtures, presumably flush valves on the third floor of nurses quarters which had undersized piping.

The *Engineering News-Record* for October 12, 1939, reported that, at Cleveland, Ohio, liquid paraffin was turned into the city water mains through error by an operator at a Standard Oil Refinery Plant. The paraffin plugged solid over 600 ft. of 8-inch and considerable 6-inch piping and many services. Removal of the obstruction cost $3,000.

A water-borne epidemic of *Brucella melitensis* (18) of 80 cases was believed to have been caused by back-siphonage of cultures dumped into sinks with submerged inlets and aspirators. Stearns (17) reports that users of a swimming pool at Staten Island at times observed noticeable lowering of water level in the pool. Later, it was found to be caused by back-siphoning into the water system.

The International News Service reported that at Vallejo, Calif., on August 25, 1940, "Mare Island's fresh water supply was shut off temporarily . . . after someone at the Navy Yard mistakenly opened a wrong valve, permitting salt water to flow into the fresh water pipes. Rumors immediately swept through Vallejo that someone had poisoned the water supply, and telephone lines to Vallejo newspapers and the Police Department were jammed for an hour with calls from wives of Navy Yard employees. The commandant of of the Navy Yard issued a statement, explaining that all the trouble wasn't too serious—that it was only an error by somebody who opened the salt water valve."

During a fire at the San Francisco Fair on August 26, 1940, polluted salt water was pumped directly into the domestic water system from a number of points, exposing many visitors from all parts of the country to possible water-borne diseases (19).

Recent Los Angeles happenings (20) include several examples of dangers involved in cross-connections. On a U. S. Army flood control project in the area, engineers surreptitiously installed two large pumps which created 250 lb. per sq.in. pressure in a temporary water line fed by fifteen city services at less pressure. In this way polluted

river water was pumped into the city water system. In another instance, at a large department store, a drinking fountain line was found to be supplying a refrigerator cooling coil and discharging into a sewer, 5 ft. higher than the fountain. Luckily the discovery was made prior to the contamination of the fountain. In still another case 10 cu.ft. of sulfur dioxide escaped under high pressure through a leak in the cooling coil of a refrigerating unit at a local civic building. A 10,000-gallon water storage tank indicated a sulfur dioxide content of 1,440 p.p.m., and a negro janitor, on washing his face with the water, complained of sunburn. Finally several instances have been reported where carbon dioxide escaped from cylinders, having faulty pressure reducing valves, into copper tubing water services. In one of these cases water of 230 p.p.m. copper was served to patrons of a drug-store eating counter. Similar instances are legion.

The present dilemma is serious. The question can rightly be asked: Of what avail is it to protect plumbing fixtures against back-siphonage which for the most part affects only users in the building in which it occurs when the larger cross-connections, where a considerable number of consumers on distribution systems become affected, are still allowed to exist? Why do some cities protect only hospitals, milk plants, and restaurants against back-siphonage and allow all other inter-connections to continue? Why is the raising of inlets above overflow of fixtures made compulsory in many cities where no provision is made to correct dangling hose which is later attached to them to prevent splash and noise? Why is it that back-flow valves are placed in the basement on sewer lines to prevent sewage backing into buildings, when not even a pretense is made to prevent sewage from backing up into water fixtures? Why is it that a number of states and cities absolutely prohibit any type of physical connection of a domestic water system with a secondary source of supply, yet allow swing connections, which may alternately be fed by either supply, when a reversal of flow immediately after the drinking water supply is connected with such a system, already filled with polluted water, would result in gross contamination of the drinking water?

Many cities are enlarging water pipe sizes to prevent the creation of vacuums, yet, simultaneously, are permitting direct connections to boilers, which may create greater vacuums than can otherwise normally occur. Some cities prohibit the installation of pumps directly on water mains, yet allow fire engines to pump sewage or

polluted water into fire sprinkling systems or directly into hydrants on the domestic water system. Many plumbing codes prohibit hose connections in laundry trays, but provide no way for making a positive retracting hose connection and also take no cognizance whatever of direct water services submerged in sewer flushing tanks. All cities design the distribution system for fire protection and fire use, so far as size and privileges are concerned, and, at the same time, require water consumers, using domestic water services, to pay for the very fire protection facilities which so often jeopardize their domestic supply.

Why, when large steel water transmission lines are protected with air inlet valves to prevent physical collapse when drained, is no provision made to satisfy vacuums created in cast-iron lines which are strong enough to resist structural failure but which expose house piping systems to their greatest back-siphonage dangers? Why is it that some cities require separate systems, yet have no means of preventing future cross-connections where back-flow can be established between the two systems? Why is it that many cities attempt to enforce an air-gap break as a cure-all for all types of inter-connections and yet allow the use of flush valves which violate this principle? These and many other inconsistencies can be pointed out to demonstrate the need for analyzing the different factors involved in the creation of back-flow and back-siphonage, and the necessity of applying a uniform procedure in the elimination of the various types of connections. Many types of cross-connection protection units, such as double check valves, tanks with overhead discharge, and swing connections, are either unreasonably expensive, or fail to give desired protection. Certain types of inter-connections, such as those made directly to sewers or drains carrying fecal matter and those to lines or tanks containing poisonous chemicals, must be outlawed, because mechanical devices have not yet been developed for satisfactory protection. It is essential that as uniform a pressure as possible be maintained at private taps; that vacuum conditions be relieved as soon as possible, whether in the street main or a private water piping system; that mechanical devices, which will relieve vacuums, provide air gaps and drain pressure in private piping system below that of street main pressure, be developed; and that proper plumbing fixtures, protected, on the discharge side of checks, with vaccum breakers or their equivalent, be installed. Such a program should uniformly apply to cross-connections and inter-connections of all types.

The personal element must also be considered. Systems of protection, as well as materials for water, sewer and safe waste lines, must be made foolproof against ignorant mechanics, unlicensed plumbers and the action of property owners.

IV. Summary of Connection Protection and Back-Flow Control Procedures Throughout the United States

A recent questionnaire sent to all states and all large, as well as representative, cities throughout the United States reveals that very little unified progress has been made throughout the country on the matter of cross-connection, inter-connection and back-flow protection. Over 150 replies, giving a good cross-section of the present practice throughout the country, were received. The information of these replies will be discussed in the following sections.

A. State Board of Health Requirements

All states have passed basic legislation delegating powers to their respective state health boards to supervise the safety of the collection and distribution of water. In no instance has specific mention been made of cross-connections and plumbing hazards in such state legislation. These matters are either taken care of by plumbing codes, sanitary codes, or state department of health regulations. In most instances the state requirements do not include jurisdiction inside private property lines and therefore fail to supervise adequately the water supply up to the points of actual use.

Replies from 44 states give a very clear picture of the considerable progress that has been made in the protection against cross-connections with dual water supplies and the very little progress in the control of connections of all other types.

Thirty-nine states, representing 88.5 per cent of the states replying to the questionnaire, have specific regulations on dual supply cross-connections. The following states absolutely prohibit any physical connection with an unsafe, unapproved, or unauthorized supply: Arkansas, Florida, Idaho, Illinois, Kentucky, Maine, Minnesota, New Hampshire, Ohio, Oklahoma, Oregon, South Carolina, and Tennessee.

Certain other states prohibit any new connections to any unsafe supply after a given date but permit continuation of existing connections prior to that date, provided subsequent inspection indicates that a double check valve installation adequately protects each

water supply in question. These states are: California, Colorado, Connecticut, Delaware, Indiana, Kansas, Maryland, Massachusetts, Michigan, New Jersey, New York, Rhode Island, Washington and Wisconsin.

Eight states have no definite regulations on cross-connections but carry on educational programs for cross-connection elimination. It is apparent that the progress of cross-connection elimination through state board of health action has met with definite success throughout the entire country. One outstanding observation is that in nearly all states no mechanical device, except double check valves, is allowed between unsafe supplies and domestic water supplies.

Three states—Indiana, Louisiana, and Massachusetts—permit installation of swing connections and the insertion of temporary connections during emergencies, provided such occasions are reported to health department representatives.

Rigid inspection rules covering maintenance of double check valve installations are enforced in Kansas, Maryland, Massachusetts, Montana, New Jersey, and Wisconsin. A particularly desirable provision in the Wisconsin Code enables the state health department to order out any double check valve installation which has been previously approved but which on thirty-day inspections is found to be faulty.

Some few states, including Connecticut, Delaware, Indiana, Massachusetts, Michigan, Ohio, and Oregon, have specific regulations governing substitute arrangements to void cross-connections, including overhead inlets above the overflow level of tanks which, in turn, may supply unsafe distribution lines. Tennessee, in 1940, required all cities to pass ordinances to eliminate cross-connections with dual supplies and withheld approval of public water supplies until satisfactory reports were received from each city (21).

Regulations should also provide that unsafe supplies be piped separately (e.g. in Connecticut and Delaware) and be painted red, all taps being placarded as unsafe (e.g. in Michigan). Several states, following the lead of Colorado and Massachusetts, permit swing connections or inserted sections which connect or separate dual supplies manually. This practice inherently violates back-flow hydraulics and is a definite health hazard. Such regulations should be repealed or amended to include protection with special mechanical devices.

Four states require double check valve installations between the public water supply and safe dual supplies. All states should amend

their regulations to require mechanical protection of some type for the so-called safe supplies. Obviously, bacteriological control of private water supplies can never be as good as that on public systems; nor can the supervision, permanency of employment, adherence to specifications, or reliability in operation afforded by public water systems ever be met by all private supplies. Owing to the uncertainty as to when a so-called safe private supply may become unsafe, it is logical that all private supplies should be considered less safe than the city water supplies.

Although a number of states are conscious of a broader scope of connections than those existing between dual supplies and domestic water supplies, only eight—Kentucky, Maine, Minnesota, New Hampshire, New York, North Dakota, Oregon and Wisconsin—can be considered to have adequate and effective regulations against back-flow and back-siphonage.

A few states, e.g. Alabama, Arizona, Georgia, Idaho, Louisiana, Mississippi, Pennsylvania, and Texas, carry on considerable publicity regarding the elimination of cross-connections without legislation.

The regulations of a number of states cover the maintenance of separate supplies with overhead inlets. Still other states have plumbing codes which ignore the problem of back-flow and back-siphonage. Washington, as well as Ohio, is particularly progressive in the manner in which fire protection services are handled.

Some states have become interested in protection against special types of connections. Colorado now outlaws the low inlet to frostproof toilets and Illinois has an excellent regulation prohibiting inter-connections and cross-connections, including prohibition of submerged inlets and direct connections to sterilizers, but this applies only to maternity homes. This latter regulation states: "The plumbing system shall be free from cross-connections or inter-connections between safe and unsafe supplies or between safe water supplies and sewage, waste, drainage, condensate, perviously used water, contents of plumbing fixtures, or material of similar nature."

Montana regulations cover sewer inter-connections as follows: "No direct connection shall be made between water supply piping and sanitary sewers, but there shall be provision for discharge of the water into an approved intercepting hopper or sink."[5]

[5] Regulation 101 (d).

One engineer, in a state where no attempt has been made to control water piping and plumbing, states: "In regard to the subject of back-flow and back-siphonage in plumbing installations, I think the danger here has been considerably exaggerated."

B. Progress in State Legislation

Noteworthy progress has been made in twelve states, as far as plumbing connections are concerned, as follows:

1. Connecticut

In 1936, Connecticut adopted a broad plumbing ordinance specifying that there be no contamination of water piping systems from drainage systems and that no inter-connections be maintained between safe supplies and drains from refrigerators or from air-conditioning and other mechanical equipment; that no sewers be located over tanks or connected directly to overflows; that submerged inlets to sewer-connected fixtures be eliminated; that flush valves be protected with vacuum breakers; and that sanitary drinking fountains meet rigid requirements. A section of the Connecticut Code states: "No plumbing fixture nor waste outlet shall be installed which shall provide a cross-connection [inter-connection] between a distribution system of water for drinking and domestic purposes and a drainage system, soil, or waste pipe and permit or make possible the back-flow or back-siphonage of sewage or waste into the water supply."

2. Indiana

This state has just revised its plumbing code for 1940 to include control of unsafe plumbing and installation of vacuum breakers.

3. Kentucky

Kentucky passed a state code on water piping in 1937, fixing $\frac{3}{4}$ in. as the minimum size of service, setting a basis for the determination of size of house piping, prohibiting submerged inlets, direct connections to sewers or waste lines, including refrigerant ice-box flow drains, receptacles storing food, water-cooled compressors, hydraulic elevators, and steam boilers. No fixture may be installed which has not received approval from nationally recognized laboratories, guaranteeing that there shall be no return of the fixture's contents into water lines.

4. Maine

Regulations, in Maine, were passed in 1937 and are quite similar to those of Kentucky, including provisions against direct connections to boilers. There is no specific mention of vacuum breakers in either the Kentucky or Maine regulations.

5. Minnesota

Minnesota attacked its back-flow and back-siphonage problem in 1939 and was the first state to set up rules applying to the installation of water pipe, including street mains and service pipe. Its regulations cover such matters as selection of pipe according to the character of the soil and a prohibition against use of second-hand pipe. According to the rules a minimum distance between water, sewer or storm drains, equal to a wall-to-wall distance of 10 ft., must be observed except where such distance is impossible, in which case a layer of compact clay must be placed between the water and sewer lines. In addition the regulations set up provisions to prevent pollution of trenches, by workmen, during construction and require that water pipes be laid in the same trenches as sewers *only* when constructed on a solid shelf, and that, in such cases, they be 2 ft. apart and the water line be protected with bell-joined clamps equipped with rubber gaskets to prevent leakage. Furthermore, it is required that water pipe lines shall not contact or pierce manholes; that the water trench shall be back-filled with 12 in. of compact earth above all pipes and trenches; that special precautions be taken to insure tight sewers and sewer manholes; that sewers cross under water pipes; that sewers, shallower than 5 ft. shall not be within 10 ft. of water lines, unless the latter are protected against leakage and the sewer drains are constructed of extra heavy cast-iron soil pipe. The state rules covering plumbing surveys, which are a part of the water supply routine investigation, include schools, residences, photographic galleries, sewage treatment plants, water purification plants, theaters, cemeteries, mortuaries and twenty-two listed types of industrial plants, all of which require checking for all types of cross-connections and inter-connections. The scope of these regulations is greater than that of other state codes but still does not include all uses to which water may be put. In addition to the regulations cited the plumbing code of Minnesota generally provides that there be no drawback of the fixture water into the water supply lines;

covers fully the subject of vacuum formation; and deals with the dangers of submerged inlets.

6. New Hampshire

In 1938, following the adoption of adequate codes, New Hampshire issued a manual to plumbing boards and water superintendents, on "Contamination of Water Supplies by Back-Siphonage," covering cross-connections and inter-connections. In addition to the provisions mentioned above in connection with other states, the New Hampshire code covers the matter of vacuum breakers and of special consideration for unusual uses of water; and prohibits connections to swimming pools and boilers, as well as outlawing the rear- or side-inlet spud to flush valve inlets.

7. New York

The sanitary code in New York was published in 1937. Besides covering such items as distribution, water service, size of water supply lines, water supply control, water supply pipes and fittings and other matters, it includes a section as follows:

"No plumbing fixture or device shall be supplied directly from a water supply system through a flush or other valve unless such valve is adequately protected to prevent pollution of the water supply.[6]

"No plumbing fixture or device shall be installed which will provide an inter-connection between a distributing system of water for drinking and domestic purposes and a drainage system, soil, or waste pipe or make possible the back-flow of sewage or waste into the water supply system."[7]

Further, paralleling regulations in Kentucky and Maine, the code allows neither direct connection with swimming pools nor interconnections with refrigerators and similar receptacles having drains.

8. North Dakota

North Dakota, in 1940, defined cross-connections on a very broad basis to cover hazardous connections in water supply piping. Present regulations prohibit the direct connection of air-conditioning equipment to water and waste lines and the use of aspirators of surgical and dental equipment operated by water ejectors. In addition,

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[6] Section 84, Article 7; Standard Plumbing Code.

[7] Article 7, Bulletin 23; New York State Department of Health.

they prohibit automatic devices for filling tanks, boilers or vats through a submerged inlet with overflow connections to the sewer, direct connections to swimming pools, cellar drains of the water ejector type, flushometer type toilets without vacuum breakers, water priming pumps of all kinds, combination faucets, flush tanks in sewer lines, drinking fountains with submerged faucets, hospital equipment with submerged inlets and direct waste connections, bidets with submerged inlets, and all other fixtures or conditions whereby contamination may enter the city water system. Of special interest is the inclusion of flush tanks on sewer lines under a specific regulation.

9. Oregon

Oregon is one of the most progressive states as far as back-siphonage protection is concerned. Regulations prohibit the use of any fixtures or devices containing water supply pollution hazards; require vacuum breakers and siphon preventers on all fixtures making back-siphonage possible; and allow vacuum breakers on submerged inlets which are unavoidable. In addition, the state department of health issues lists of fixtures and protective devices which meet with its approval.

10. Tennessee

In 1940, Tennessee waged a vigorous campaign on cross-connections, requiring cities to pass ordinances and to report on such conditions as direct connections to sewers, drains, conduits, pools, storage tanks, and other devices containing sewage or other waste or liquid which would be capable of importing contamination into the public water supply. This procedure of requiring that the state board of health order the cities to pass ordinances and to report on their progress in eliminating dangerous connections as one phase of a rating and approval program for the city water supply is an excellent method of passing on responsibility for the adequate protection against health hazards.

11. Virginia

Virginia is the only state which has adopted a code item based on the minimum requirements of the U. S. Department of Commerce. These requirements cover water piping but are not specific in regard to back-flow and back-siphonage protection.

12. Wisconsin

Wisconsin has long been in the lead as far as plumbing requirements are concerned. Its code, last amended in 1937, covers water supply piping sizes, submerged inlets, use of vacuum breakers, painting of "impure" lines, and outlaws the side- and rear-inlet spuds to flush valve toilets. The code also requires elimination of direct connections to sewer or impure lines; forbids location of sewers over tanks; and stipulates that all equipment connected to the water supply lines should comply with the purposes set forth in the code.

It is to be observed that the most constructive work on back-flow and back-siphonage has occurred during the past three years. Kentucky, Maine, and Wisconsin, in 1937; New Hampshire, in 1938; Minnesota, in 1939; and Tennessee, Indiana, North Dakota, and Oregon, in 1940 made notable progress in the field. At the present time none of the state requirements are consistent or all-inclusive. There should be a uniform practice in all states as far as standards are concerned. Whether these standards should be included in amended plumbing codes, to include water piping, or in separate water codes is not important. Suffice it to say that in at least 38 states the attention paid to connection protection in its broadest sense is inadequate.

C. Back-Flow and Back-Siphonage Control by Municipalities

To simplify the discussion of what various cities are doing regarding cross-connection, inter-connection and back-flow protection, an attempt has been made to group some of the best practices, as shown in quotations from municipal codes and regulations (*see* Appendix, p. 458), under an outline plan including all types of connections. The outline is as follows:

1. Solid connections to sewer lines (inter-connections)
   a. Continuously open
   b. Manually operated
   c. Accidentally inter-connectable
   d. Through devices other than fixtures
   e. Conclusions
2. Connections to water fixtures attached to sewer lines
   a. General provisions against back-flow through plumbing fixtures
   b. The flush valve problem
   c. Submerged inlets to sewer-connected fixtures

3. Inter-connections to fixtures connected with special waste pipes
4. Water pipe extensions representing used or altered water
   a. Water which has been altered with poisonous chemicals
   b. Water which has been rendered aesthetically undesirable
   c. Stored water
   d. Submerged inlets to fixtures or devices not connected to sewers
   e. Miscellaneous uses resulting in used or altered water
5. Water-operated devices connected with gas, compressed air and liquid substances other than water or sewage
6. Cross-connections with dual supplies
   a. Polluted dual supplies
   b. Safe dual supplies
   c. Conclusion
7. Pumps and pressure producing devices on water lines
8. Vacuum pumps and vacuum producing devices
9. Steam generating units
10. Fire service connections
11. Piping in old buildings equivalent to inter-connections

The references to municipal codes and regulations in the following discussion are admittedly incomplete, as they are based only on returns from questionnaires. Undoubtedly there are many good practices in various other cities which are not recorded here. The discussion is, however, indicative of present municipal practices in the various types of protection.

1. Solid Connections to Sewer Lines (Inter-Connections)

a. Continuously Open: Connections to sewer lines which are continuously open are dangerous when sewage backs up and low or negative pressure exists in water lines. In this category, and where connections to sewers exist, there are included services to automatic sewer flush tanks, overflows from cold and hot water tanks and reservoirs, lines serving cooling jacket water to diesel engines, gas engines, compressors, stills, retorts, pasteurizers, vats, coolers, grease traps and refrigeration units, and services to gas scrubbers, direct-connected air-conditioners, and water lines to steam condensers.

Sewer flush tank services are usually jets which are set from 7 to 20 ft. below street level and which are continuously open. Flush tanks are installed where grades are flat and flooding is common. Flush tanks, when not in proper operating condition, are frequently found with the water services submerged. Their services are, therefore, direct connections to sewers and are particularly dangerous. Many direct sewer connections can be eliminated by using a broken connection. The sewer flush tank service requires special attention and is a serious problem.

Only six cities—Kansas City, Mo. (a),[8] Minneapolis, Minn. (b), Mobile, Ala. (c), Newark, N. J. (d), Portland, Ore. (e), and Syracuse, N. Y. (f)—in the entire United States, in addition to those which have adopted the state plumbing code in New Hampshire, recognize and have legislated against inter-connections between water and sewer lines in public streets. In two of the cities—Kansas City and Mobile—the legislation is enforced by the water department and in the other cases, by the health department. Bismarck, N. D. (g), is the only city which prohibits direct water services to sewer flush tanks.

The cities just mentioned, together with Baltimore, Md. (h), Madison, Wis. (i), Miami, Fla. (j), Newark, N. J. (k), Omaha, Neb. (l), Providence, R. I. (m), Sacramento, Calif. (n), and St. Paul, Minn. (o), prohibit, in broad terms, any connection between water and sewer lines on private premises whereby back-flow and back-siphonage might occur. The ordinances of Columbia, S. C. (p), and St. Louis, Mo. (q), prohibit tank overflow connections directly with sewer lines. El Paso, Tex., prohibits any hot or cold water connections to sewers (r) and prevents the direct connecting of overflows from hot-water heating systems to vent or soil lines (s). Los Angeles (t) also prevents direct connections of hot or cold piping to sewer lines. Jacket cooling water connections to sewers, except with air gaps, are prohibited at Newark, N. J. (d). New Orleans, La. (u), prohibits connections with water cooling devices to the sewer. Newark, N. J. (v), and Sacramento, Calif. (w), regulate jacket water connections to sewer. Direct connections to sewers involving air-conditioners are outlawed at Newark, N. J. (d), and

[8] Letters in parentheses throughout this section (Section IV) refer to quotations from municipal codes and regulations which appear, similarly identified, in the Appendix (p. 458). The order of designation there is as follows: (a) through (z); (aa) through (az); (ba) through (bz); etc.

Bismarck, N. D. (x). Only one city—Syracuse, N. Y. (y)—specifically prohibits direct water lines to steam condensors which are sewer-connected.

b. Manually Operated: Direct connections between water-sewer lines which are manually opened are theoretically less dangerous than those which are continuously open, but separating valves are subject to corrosion from sewer gas and usually leak after several years of service thus making it possible for sewer gas to pass up lines sloping upward even against a higher water pressure. There is no safety in such connections even when the operator realizes the danger of opening separating valves when the water pressure is low or when the sewage has backed up. Typical inter-connections of this type, when connected to sewer lines, include: manually-operated sewer flush-tank services; direct house drainage pipe connections for flushing; hopper closets with flush valves; drains from tanks, reservoirs, fire sprinkling systems, hot water, ice water, and secondary systems; de-aerator drains; backwash lines from filters and softeners; connections to sewage pump priming lines; sewage Venturi meter leads and sewage wet-well float chambers; weep lines from fire hydrants; and services to hydraulic elevators.

Fire sprinkling drains have generally been installed from between the terminal ends of fire sprinkling systems directly to a sewer, separated by a single valve. These provisions have been fostered in the past by representatives of the National Board of Fire Underwriters to facilitate the making of periodic flow tests and the draining of lines for repairs. The valve separating the water and sewer system is subject internally to sewer gas corrosion and may leak considerably before the existence of such flow is noticed at the detector check meter. Such a condition is conceivable in some buildings which have been inspected, where considerable sewage head may exist at the fire sprinkling system drain.

Priming lines to sewage pumps of the centrifugal type may be found, either on the suction or discharge side, to expel air or gas from the pumping chambers and suction lines. The full head of sewage acts directly on the water service. Similar connections exist on wash-out leads to Venturi meter lines to prevent sewage solids from contacting mercury pots, and in sewage-level float-control lines to keep the floats, which rest in the sewage, free. Although the valves separating water and sewage on pump priming lines, the Venturi leads and the sewage-level float-control lines may be protected

by check valves, such protection is inadequate. Both check valves and gate valves, because of the nature of the materials being handled, may easily develop leaks. The backwash lines from filters and softeners to sewers often take city water for suction and force the dirty water to the sewer. In many cases these facilities are located below street level and closed connections to sewers higher than the filters, placing them under a positive sewage head, have been found.

The hydraulic elevator connection in the crudest installations is a three-way valve. City pressure is used to raise the elevator. Release of the water pressure is to the sewer through the same valve. Such a connection, under low water pressure and high sewage head, although such conditions are not likely to occur simultaneously, may result in the pumping of sewage into the water system or, if the valve is faulty, in permitting it to leak by. All inter-connections in this category should be protected by broken connections.

The language of ordinances having provisions against direct sewer connections to water lines applies equally to connections which are subject to temporary and to intermittent use. It is interesting to note that several cities have found it expedient to mention interconnections of this type specifically, in their respective ordinances. For instance, frost-proof closets having supply valves wasting into soil or sewer lines are prohibited by Omaha, Neb. (z), and by New Hampshire cities (aa), unless they are supplied from separate tanks. The only reference to prohibition of direct connections to sewage pump priming lines was found in the recent El Paso, Tex., ordinance (ab), although most cities are enforcing such a requirement. Hydraulic cellar drains are prohibited by Detroit, Mich. (ac). Hydraulic elevator services, where direct connections to sewers exist, have been legislated against specifically by El Paso, Tex. (ad), Madison, Wis. (ae), Newark, N. J. (d), the State of New Hampshire (af) and Sacramento, Calif. (ag).

c. Accidentally Inter-Connectable: Serious inter-connections between water and sewer lines may occur under the various circumstances, including: (1) breaks in water and sewer lines laid in the same trench; (2) the repair of water lines in trenches containing leaky sewers; (3) the filling of trenches through fire hose during construction; (4) the laying of water lines through sewer manholes when the lines have been made to leak from the action of sewer gas, settlement or any other cause; (5) the location of sewer lines, which sub-

sequently may leak, over water- or ice-storage tanks; (6) the use of hose connections, which are non-retractable and which are affected by the backing up of material, for sprays, showers, cleaning or silencing during the back-filling of trenches; and (7) the householders' use of a "plumber's friend," an attachment to a water faucet and sink drain to force water directly into drain lines.

Only one city, Minneapolis, Minn. (ah), was found to prohibit the placing of water and sewer lines in the same trench in city streets. On private property, both Minneapolis (ah) and St. Paul, Minn. (ai), prohibit use of the same trench for water and sewer lines.

The location of sewer lines directly over water and ice storage and handling places is prohibited by El Paso, Tex. (aj), and Madison, Wis. (ak). The need of applying the Minnesota State Board of Health suggestions regarding precautions in constructing water and sewer lines is obvious.

d. Through Devices Other Than Fixtures: A number of water-operated devices through which solid and direct sewer connections exist during periods of operation are particularly dangerous. Fixtures of this type require the city water pressure, but may or may not put the water to other beneficial purpose. Such devices include water-operated sewage ejectors, bilge basement pumps, pumps for boiler blow-offs to sewers, sewage-sludge vacuum filters, direct-pressure-pump sealing-ring connections, sewage chlorinators, sewage ozonators, chillers, drains from turbo-burners, colonic irrigators, ejectors used by morticians and autopsy surgeons, water-operated cuspidors, washing machines of the "Bendix" type, and hose connections to fire engines taking suction from sewers and using the domestic water system for fire fighting purposes.

Water supply connections to chlorinators and ozonators for sewage treatment are technically a bad type of inter-connection. Some types of these chlorinators are designed to shut off the chlorine flow when the water supply fails, leaving a direct connection to the sewers protected only by a check valve.

The water-operated sump ejector is usually located at the lowest point in a building and if it is situated 34 or more feet below the elevation of the next lowest service, it provides means whereby a sewage head may back up against the water supply. A check valve is usually provided.

Manufacturers are now designing colonic irrigators with a break in the water inlet line. Without such protection they constitute an

inter-connection, not only between the water supply and the sewer system but also between the water supply and human intestines where alternate reversals of pressure and partial vacuums are frequent.

The washing machines of the "Bendix" type employ automatic valves between the water and sewer lines and are connected to a pump. As yet, the manufacturers have not worked out a safe method of protection.

The ejector used by morticians and autopsy surgeons is a device to de-water cadavers and to provide a washing stream of good water. De-watering is accomplished by using city water as an aspirating pump; then flow is reversed by mere pressure of the thumb. It is surprising how little recognition is given to protection from this type of inter-connection.

Direct water connection to sewage and basement bilge pumps is prohibited by Bismarck, N. D. (al), Detroit, Mich. (ac), El Paso Tex. (ab), and Sacramento, Calif. (am). Detroit alone allows hydraulic cellar drainers and sump pumps to be operated with safe water, provided a vacuum breaker has been installed one foot above the fixture, at overflow level (ac).

c. Conclusions: In all cases where legislation has been formulated, direct water and sewer connections are prohibited, except, as noted, at Detroit. This unanimous opinion, by representative cities throughout the country, should be noted by those municipalities which at present ignore the back-flow and back-siphonage problem.

2. Connections to Water Fixtures Attached to Sewer Lines

There are two general types of inter-connections and back-flow connections in plumbing fixtures which vary primarily in the degree of danger involved. The first type includes toilets and urinals operated by flush valves, toilets with integral tanks and valves for silent flushing, bed-pan washers, and bidets. In these instances, water inlets may be submerged in sewage when the fixtures are flooded, but the sewage head at the water inlet is relatively low and is not as dangerous as a solid connection. Such devices under back-flow conditions may draw sewage into the water line from submerged inlets, while air is taken in through out-of-water openings. There is also danger that solid material, bearing pollution, will be carried bodily into the water line from the sides of the fixture, by air attempting to satisfy the water-line vacuum (22).

The second group of sewer-connected fixtures includes drinking fountains, basins, sinks, hoppers, home air-conditioning units, steam-table connections, hydraulic-elevator surge tanks, tanks, bath tubs, vats, spring-loaded glass washers, washing units for garbage and milk cans, shrinking tanks, dipper vats, dishwashers, dental cuspidors, laundry washers, photographic tanks, laboratory water-operated vacuum pumps, and hose connections. Ordinarily these fixtures are not supposed to contain sewage, except when stoppages in sewer lines occur, in which case the lowest fixtures overflow. In many instances the inlet can be raised and all possibility of back-flow eliminated; but there are many instances where, due to a need to silence inlets to prevent splash and to perform essential functions, submerged inlets are desirable.

A discussion of those types of plumbing fixtures which use water pressure for miscellaneous purposes is included under Topic 4d of this section.

a. General Provisions Against Back-Flow Through Plumbing Fixtures: A number of cities have in their plumbing regulations used very general language, such as the wording of the ordinance by which St. Paul, Minn., regulates plumbing fixtures—prohibiting any fixture which "will provide a cross-connection [inter-connection] between the city supply and a drainage system, soil or waste pipe, so as to permit or make possible the back-flow of sewage or waste into the supply system" (an). Similar broad provisions have been adopted at Baltimore, Md. (ao), Bismarck, N. D. (ap), the District of Columbia (aq), Kansas City, Mo. (ar), Lincoln, Neb. (as), Madison, Wis. (at), New Hampshire cities using the state code (au), New Orleans, La. (u), Omaha, Neb. (l), Pittsburgh, Pa. (av), Sacramento, Calif. (aw), Spokane, Wash. (ax), Syracuse, N. Y. (y), and Tacoma, Wash. (ay).

Some of these cities, together with others, have specialized on more specific methods of control and have segregated the flush-valve problem from their consideration of other types of plumbing inter-connections.

b. The Flush-Valve Problem: Flush valves have become almost indispensable, yet they constitute a very dangerous type of connection. A flush valve, whether of the diaphragm or piston type, is a fixture in which a release of water pressure opens the water line for flushing action and in which water pressure, through an auxiliary bypass, closes the line within adjustable time limits. The valve itself may be stable or non-stable, but the by-pass chamber is subject

to automatic opening under vacuum conditions. The capacity of the bypass, together with the amount of valve leakage, constitutes a direct sewer connection. Adequate protection involves supplying the valves from separate tanks with free-falling inlet water, or the development of safe types of mechanical protection. Regulations concerning flush valves constitute by far the bulk of plumbing legislation against inter-connections. This type of connection also represents a field where a wide disparity in practice still obtains.

Philadelphia, Pa. (az), has outlawed the use of flush valves on any domestic water line and has required that flush valves be serviced from tanks which have air gap inlets and are used for no other purpose. This is a drastic action which greatly increases the cost of plumbing. When it is realized that "bootleg" connections may be made by property owners after the original installation, it is evident that a personal element, which must be balanced by the reliability of mechanical devices, enters the picture.

An orderly evolution of increased protection against the dangers of flush valves is clearly reflected in the present ordinances. The first major attack on their use was made by prohibiting side- and rear-spud inlets to closet bowls equipped with flush valves. Such legislation is illustrated by ordinances at Detroit, Mich. (ba), Madison, Wis. (bb), and Omaha, Neb. (bc), and by the New Hampshire State Code (bd). Manufacturers have fallen in line and no longer supply bowls with side and rear inlets.

A second development was the requirement that the flush valve be located above the overflow rim of the fixture. No distance was fixed, however, and although the location was to be such that no pollution of the water supply would result, the mere location of the flush valve above the toilet bowl is inadequate. Cities which specify that flush valves shall be located above the toilet bowl include Bismarck, N. D. (be), Detroit, Mich. (bf), Lincoln, Neb. (bg), New Hampshire cities (bd, bh), St. Louis, Mo. (bi), St. Paul, Minn. (bj), Spokane, Wash. (bk), Tacoma, Wash. (bl), and Wilmington, Del. (bm).

Still another development is one represented by the Los Angeles ordinance (bn) which requires that flush valves be stable under vacuum conditions or, that being impossible, that check valve integrals be used with unstable flush valves so that the only vacuum reaching the toilet bowl is that which passes a leaky check valve and the flush-valve auxiliary bypass. Most manufacturers met this

requirement quickly, in the case of piston type valves, by using double cup leathers, and, in the diaphragm type, by increasing the weight.

A final development was the use of vacuum breakers and the specification of a definite height above both the toilet bowl and the intervening vacuum breaker. Such vacuum breakers are intended to satisfy the residual vacuum passing the leaky stable piston and its auxiliary bypass without putting sufficient lift on the toilet bowl to raise liquid to any air inlet.

Cities having this type of protection include Bismarck, N. D. (bo), Detroit, Mich. (bf), El Paso, Tex. (bp, bp-1, bq), Los Angeles, Calif. (t), Miami, Fla. (br), Minneapolis, Minn. (bs), New Bedford, Mass. (bt), New York, N. Y. (bu), Omaha, Neb. (bv), Sacramento, Calif. (bw), St. Louis, Mo. (bx), Sioux City, Iowa (by), and Wilmington, Del. (bz). El Paso requires that the vacuum be 3 in. above the toilet bowl (ca), New York specifies 4 in. and Sacramento 6 in. El Paso further requires, as does Los Angeles, that the vacuum breaker be an integral part of the flush valve (ca).

Some cities, such as Bismarck (cb), have prohibited bidets and bed-pan washers which are similar to toilet fixtures. New York permits these fixtures if they are equipped with check valves and vacuum breakers (cc).

Integral tank and closet bowl combinations are covered by ordinance requirements at Detroit (bf). Protection of ball-cock supplies to closet bowls is required by Detroit (cd), New York (ce), and Portland (cf). This is required not so much because sewage backs up into such tanks but because of the polluting material which is thrown into them for disposal.

From the experiences of cities all over the United States, it is apparent that connections through toilet and kindred fixtures must be protected. No standard practice has yet crystallized, but it would seem that the following requirements are logical: top inlet bowls; stable flush valves; vacuum breakers between flush valve and 4 in. above rim of bowl; and a specification for the vacuum breaker, regarding design, operation, maintenance and testing.

c. Submerged Inlets to Sewer-Connected Fixtures: Submerged inlets to sewer-connected fixtures fall into two categories: first, those such as basin and bath-tub inlets which can be raised above the overflow level and thereby avoid being an inter-connection; and second, those which must remain submerged for functional advantages.

Air gaps for inlets to sewer-connected fixtures are generally required. Bismarck, N. D. (cg, ch), prohibits submerged inlets on all fixtures other than flush valves. This regulation pertains to drinking fountains in particular. Detroit, Mich. (ci, cj), requires that all hose connections to inlets of basins and other waste fixtures be equipped with a counter-weight or a spring reel which will prevent the open end from remaining below the rim of the fixture; and also requires (ck) that inlets to drinking fountains be $\frac{1}{4}$ in. above the overflow rim. Newark, N. J. (cl), requires an air-gap inlet to all inlets serving fixtures wherein waste is deposited. Kansas City, Mo. (ar), prohibits any water inlet into any waste fixture. Madison, Wis. (cm), tempers its prohibition on submerged inlets, requiring that they be raised where possible. The New Hampshire State Code (cn, co) provides for a raised inlet where possible, and adequate protection of all necessary submerged inlets. New York (cp) requires raised inlets except when submerged inlets are absolutely essential for proper functioning of a fixture. Omaha, Neb. (cq, cr), prohibits submerged inlets to all lavatories, sinks, and bath-tubs. El Paso, Tex. (cs), prohibits submerged inlets to sinks at all bars and soda fountains.

Protection against back-flow and back-siphonage on sewer-connected fixtures is threefold: first, where possible, submerged inlets should be prohibited; second, where submerged inlets have functional valves, they should be protected with vacuum breakers on the discharge side of control valves, when subject to manual operation; and third, where submerged inlets are used continuously, a break in a special waste line and a vacuum breaker should lead the waste discharge into an open fixture before it reaches the plumbing system.

A few cities have passed helpful ordinances controlling the protection of submerged inlets to waste fixtures. Madison, Wis. (ct), requires an improved type of vacuum breaker between the control valve and the fixture, to make back-siphonage impossible. New York (cx), New Hampshire (cv, cw) and Delaware (cu) have similar provisions. Portland, Ore. (e), permits submerged inlets where they are unavoidable, but requires the use of siphon breakers and check valves, or siphon breakers and siphon preventers.

3. Inter-Connections to Fixtures Connected With Special Waste Pipes

Most plumbing codes recognize the necessity for special waste lines which discharge into sumps or basins through an air gap.

Typical examples of this type of line are drains from boilers, refrigerators, drinking fountains, and similar fixtures, where submerged inlets exist. Pittsburgh, Pa. (cy), has an ordinance prohibiting the connection of such piping directly with the plumbing system and requiring that such piping discharge into sinks 3½ ft. above the cellar floor. El Paso, Tex. (cz), requires not only special waste lines for drinking fountains with submerged inlets, but also siphon breakers on those lines.

El Paso (da) also requires air gap discharge for drips from safe wastes. New York, N. Y. (db), requires special waste lines for aspirators and water siphons, with a vacuum breaker on the water line and a check valve between the fixture and vacuum breaker. St. Louis, Mo. (dc), permits the discharge of waste from drinking fountains into open fixtures.

The danger of such protection is that there is no assurance that future direct connections between sewer lines and special waste lines will not be made. Unless special waste lines are made of some characteristic material and painted with a unique color, and unless stiff fines are assessed for making inter-connections, this method of protection cannot be considered reliable.

4. Water Pipe Extensions Representing Used or Altered Water

The inter-connections discussed in this section are those which cover water altered with chemicals which may be poisonous or non-poisonous, water subjected to undesirable uses, water in storage, submerged inlets not connected to waste piping, and water subjected to miscellaneous uses which alter its characteristics. Such connections are either dangerous because of the poisonous pollution or the decrease in aesthetic quality of the water which may result. In any event the domestic water supply should be protected against such menaces.

A number of cities enforce protective measures against this type of inter-connection on the basis of the broad powers delegated to them, and a few have broadened their ordinance provisions to deal specifically with such cases. The Spokane, Wash., regulations (dd), for instance, cover the introduction of "any other thing whatsoever," and further specify that "no connection shall be made, or condition maintained, that would permit the entrance of any unapproved foreign matter into the water distribution system, either by gravity, siphonage or back-pressure." The Madison, Wis., regulations (de,

df) cover more than sewage in their control of back-siphonage by including "waste waters, processing liquids, chemicals, and all water and other liquids which can be polluted at some time or other." San Diego, Calif. (dg), prohibits connections whereby, in addition to sewage, any water unfit for domestic purposes may back-flow from "any equipment of any kind, class, or description." Los Angeles, Calif. (dh), includes under its prohibition connections which allow back-flow of water used for any purpose whatsoever after having passed through the city main.

a. Water Which Has Been Altered With Poisonous Chemicals: Inter-connection of the water supply with waters polluted by poisonous chemicals involve such processes as those employed in: developing and printing photographs, using chromium and silver compounds; plating, pickling and recovery of gold and silver, using cyanide and heavy metals; slime control in cooling towers, using heavy metals combined with glucosides; refrigeration, using sulfur dioxide, propane, chloroethylene and phosgene; water softening, using poisonous organic boiler compounds and sodium hydroxide or barium salts; and the preparation of hydrogen and hydroxyl zeolites, using sulfuric acid and sodium hydroxide. Also to be considered in this category are submerged inlets to chemical sinks, connections to ink machines, non-freezing solutions placed in fire sprinkling systems, and the poisonous dyes used in the dyeing industry.

The use of chemicals by janitors and inexperienced operators for water treatment and control of scale and corrosion is a dangerous procedure which may result in bacterial contamination or the addition of poisonous materials in excessive quantities.

Many chemical substances are added to process water in industrial practice. Caustic soda, caustic potash, sodium phosphate, soda ash, sodium oxalate, barium salts, and other alkaline compounds are all used in the treatment of boiler feed water. Organic compounds, added chiefly for sales value, include gum cutch, phenolphthalein, various dyes, and sugar. Passivators against corrosion include colloidal film-forming substances, such as sodium hexametaphosphate, sodium glucosate, chrome glucosates, chromates, silicates, wood extracts, aromatic amines, and aniline derivatives. Not all of these substances are poisonous, but, in any event, only impure products are purchased. No analyses which show these common substances to be chemically pure are available.

In most instances, addition of chemicals by private individuals is

an intermittent procedure in which dosing is usually excessive. Even filter companies sell alum and soda pots which at first over-treat the water and then may gradually reduce their output to nothing.

In photography it is common practice to have low water inlets into hypochlorite developing tanks, fixing tanks and washing tanks; and, particularly in the washing tanks, to use large volumes of fresh water continuously. The chemical solutions used in the process include alum, sodium hypochlorite, sodium sulfite, chromium and silver salts, and dyes. Of these chemicals, only the chromium and silver salts are poisonous; but all of them are of sufficient strength to impair the quality of the water materially. Alum, for instance, generates carbon dioxide upon access to the water system, and this, in turn, causes corrosion. It is obvious from such depreciation of water quality that all photographic equipment should be protected against reversal of flow.

Plating processes involve the use of potassium cyanide, a deadly poison, highly corrosive strong acids and poisonous heavy metals, such as chromium, cadmium, nickel and silver. All connections to the tanks in which these processes are performed obviously should be protected against back-flow conditions.

Glycerine lines in soap plants and Foamite lines at oil refineries are usually rinsed with water, a practice which has resulted in interconnections between the lines carrying these corrosive chemicals and the domestic water system. The resulting impairment of quality in the domestic supply is apparent.

New York City has health department regulations (23) which prohibit the addition of poisonous chemicals to water; restrict addition of chemicals to the eight commonly used in water treatment; and require that such treatment be administered under the direction of chemical engineers. Additional provisions require that the approved chemicals—sodium silicate, sodium bicarbonate, sodium carbonate, sodium hydroxide, sodium phosphate, calcium carbonate, calcium bicarbonate, and calcium hydroxide—be added by janitors or building superintendents *only* if they are employees of licensed firms, and that devices used to feed such chemicals be approved by the health department. These regulations are the only ones on record by which a city exercises control over the addition of chemicals.

Another practice, toward which there is a growing tendency, is the addition of silicates to hot-water systems for the control of

corrosion. Such treatment makes it likely that the many people who drink hot water upon rising will receive an overtreated water which may cause nausea and diarrhea; and for this reason the practice must be considered dangerous. Toward the control of any similar treatment practices by private individuals, it is well, here, to recommend that any faucet receiving water treated on the premises be labeled to warn consumers of that fact, or that the use of the chemical be so controlled that no danger exists.

New York, N. Y. (di), has ordinance provisions which require the use of approved check valves to prevent the back-flow of ammonia or other refrigerants into the water system because of defective coils or jackets. It is also required that refrigerants with a pressure of more than 20 lb. per sq.in. be protected by an approved relief valve, installed at the outlet side of the check valve and set at 5 lb. per sq.in. above the maximum water pressure at the point of installation.

The City of Springfield, Mass. (dj), prohibits direct water service to refrigeration systems unless the water system is protected by a vacuum-breaking or air-relief device in the connection.

Memphis, Tenn. (dk), requires that anyone desiring to treat any water supply inter-connected with the domestic water system submit complete plans and specifications for health department approval prior to construction or operation.

b. Water Which Has Been Rendered Aesthetically Undesirable: Inter-connections through which the aesthetic quality of the domestic supply may be affected include those where the water system is connected with supplies which use: lime for pH control; silicates and sodium hexametaphosphate for corrosion control; sodium glucosides for slime control; oil in water for hydraulic elevators; methyl chloride for refrigeration; non-poisonous compounds for boilers; alum, ferric chloride, sodium triphosphate and soda ash for water coagulation; hydrogen or hydroxyl zeolites for treatment; and salt for softening. Still other substances which may have an adverse effect upon the aesthetic desirability of the domestic water supply through inter-connections are: soap from dispensing systems; glue from water-jacketed glue pots; calcium and magnesium chlorides from regenerated zeolites; acid water from activated carbon filters; chlorine from disinfected water; chilled or cooled water from waste lines; cold and hot water from steam return systems; ammonia and chlorine from water ejectors during fires; de-aerated water from

de-aerators; soap from glycerine lines; petroleum and its products from refinery lines; and dyes from lines in woolen plants.

Elaboration of a few of these practices will indicate the need for definite regulation. For instance, although a laundry washing machine may not be connected directly to a sewer, soapy water may enter the water system through submerged inlets. Again, there is a growing tendency to maintain soap lines in buildings which are equipped with pumps inter-connected with water lines for flushing and diluting. And further, inter-connections through chlorinators and ozonators, not treating sewage, constitute means whereby back-flow may occur when the water supply fails.

From these instances, it should be apparent that there exist many types of inter-connections, whereby substances not aesthetically desirable may enter the domestic water system. No city has gone on record against such practices, yet, so far as consistency is concerned, the backing up of such waters into the domestic system should be prevented.

Newark, N. J., is by far the most progressive city in regard to protection against the effects of ammonia on the water supply. Its regulations require (dl) that ammonia shall not be discharged into any house drainage or sewer system; and (dm, dn) that, in the emptying of ammonia tanks (which is done during fires to prevent explosion), the ammonia be neutralized by discharging it into sulfuric acid tanks or acceptable apparatus for neutralization, without the use of water. New York, N. Y. (di), and Springfield, Mass. (dj), as already mentioned, require check valves and relief valves. Syracuse, N. Y. (do), specifies the use of a suitable check valve.

It is apparent that the Newark regulations are the most logical and that they should be adopted by other cities. The general lack of legislation against similar types of inter-connections in this classification is patent. Here again present legislation should be extended to afford consistent protection throughout.

c. Stored Water: Connections between domestic water systems and stored waters include those to basement house tanks, return water sumps, roof tanks, steamer storage tanks, toilet tanks, elevated fire storage tanks, and heat exchange tanks in laundries. Such tanks may become stagnant and unfit for use; may be polluted by vermin and insects; or, within reach of human beings, may become the targets or recipients of discarded materials.

Where storage tanks are reserved for fire protection and are not

normally subject to much consumption, their quality is materially depreciated, particularly if they are open and seldom or never cleaned.

At Philadelphia, Pa. (dp), it is required that house supply tanks be covered to exclude dust, gas and odors, a provision which should also be applied to outside tanks. Most cities, e.g., New York, N. Y. (dq), and Tampa, Fla. (dr), require a free overhead discharge into storage tanks used with a dual supply.

The connections discussed under this section involve only those storage tanks supplied with domestic water, and particularly those used for storing water for fire fighting purposes. Dallas, Tex. (ds), Duluth, Minn. (dt, dt-1), El Paso, Tex. (du), Los Angeles, Calif. (dv), Miami, Fla. (dw), New Orleans, La. (u), and St. Paul, Minn. (dx), are the only cities which protect their systems against back-flow of stored city water other than by the use of common check valves.

Where overhead discharge into tanks is recommended, Louisville, Ky. (dy), recommends 6-inch clearance; St. Paul, Minn. (dz), requires that the tank overflow be of ample size to fix the maximum level definitely; El Paso, Tex. (aj), specifies that basement tanks be constructed 1 ft. above the floor with a 2-foot clearance all around, and that they be protected against vermin.

d. Submerged Inlets to Fixtures or Devices Not Connected to Sewers: Typical of this type of connection are inlets to air-conditioning washers, baptismal founts, brine tanks, bottle washers, blue print machines, brewery vats, can washers, cheese tanks, culture vats, connections to abandoned roof tanks, cooking kettles, dipper vats, dishwashers, float-inlet watering troughs for stock or poultry, food mixing tanks, garbage and milk can washing tanks, fish ponds, hoses, hydraulic elevator surge tanks, laundry tubs, photographic washing tanks, potato peelers, shrinking tanks, soaking tanks, soda fountains, basins, swimming pools, therapeutic baths, steam tables, and washing sinks.

While a number of these fixtures can be corrected readily by raising the inlets, there are many in which submerged inlets are essential to proper functioning. The obvious action then is to provide protective devices to prevent dangerous back-flow.

The State of New Hampshire Code (ei) prohibits submerged inlets to baptistries, ornamental fountains or hydrants, aquaria, laundry and bottle-washing machines, processing machines used in

industry, and all water-connected hospital equipment. New York, N. Y. (ek), New Hampshire (ew), New Orleans, La. (u), and Providence, R. I. (el), prohibit submerged inlets to swimming pools either for make-up or filter backwash. Refrigeration and air-conditioning inlets are prohibited by Springfield, Mass. (dj). On the other hand, Syracuse, N. Y. (ej), allows submerged inlets to baptistries, ornamental and lily pools, aquaria and ornamental fountains provided that such inlets are protected by air-break devices.

e. Miscellaneous Uses Resulting in Used or Altered Water:

(1) *Lawn sprinklers:* Where sprinkler heads are subject to flooding and fertilizers have been used, back-flow of polluted material into the water line is possible. This has occurred on steep hillside lots. Cities which require check valves and vacuum breakers on lawn sprinkling lines include Detroit, Mich. (eb), El Paso, Tex. (ec), and Los Angeles, Calif. (ec-1).

(2) *Water lubrication of pumps:* Bismarck, N. D. (ea), prohibits direct water-lubricating lines to all kinds of pump installations.

(3) *Circulating systems extracting heat*: El Paso, Tex. (ed), prohibits direct services to all types of circulating systems which involve heat transfers.

(4) *All other uses:* Miami, Fla. (ee, ef), prohibits interconnections with any appliance, tank or other object using or storing any substance other than potable water, and any and all physical connections of similar types. Minneapolis, Minn. (eg), requires vacuum breakers on any connections to fixtures used for special purposes.

(5) *Connections to pumps:* New York, N. Y. (eh), requires that all connections to pumps be protected with approved vacuum breakers and check valves.

5. Water-Operated Devices Connected With Gas, Compressed Air and Liquid Substances Other Than Water or Sewage

Connections of this type are dangerous because reversal of flow, whereby substances foreign to water may be forced back into the water system, can be created by excess pressure on private premises. They should be protected with devices which will relieve excess pressure on the property side and provide a complete air gap, and should be equipped with check valves, an air gap, and vacuum

breakers. Examples of this type of connection include: direct connections to carbonators; air compressors; air lines to elevators; de-aerators; glycerine lines under pressure at soap plants; oil-well services where water is used for boiler, drilling, rotary mud tank mixing operations and neutralization of gas pressure during drilling operations; foamite systems used for fire protection; distribution air chambers into which air is pumped to correct for water hammer and surges; automobile shampoo guns; and vapo-spray equipment directly connected to water lines.

De-aerators remove oxygen from water to prevent boiler corrosion, but the effluent is affected adversely in that it is flat to the taste and is subject to the development of tastes and odors.

Services to oil well developments include water for fire protection, for domestic purposes, for boiler feed, and for heating of oil with coils in tanks. All of these uses require water under pressure. In addition, water for rotary mud mixing is required. If high pressure water is available, operators will use it, when necessary, to connect to gas and oil lines, for flushing operations prior to welding, and to run-away wells, to kill gas or oil pressure. The Los Angeles Water Department, in issuing new services, requires the installation of a tank with an overhead discharge at the property line to provide for all uses on the oil property. An alternative to such installation is the use of "E-C" valves or their equivalent (see p. 444).

Automobile shampoo devices employ water and air under pressure to mix soap and to provide a spray. The first units produced by two rival firms caused soap and air to back-flow into the drinking water systems. Devices have now been designed with special nozzles so that neither back-flow nor back-siphonage can occur. Heavy auto wash equipment, using soap and steam, has been entirely remodeled to employ a broken connection.

Water-operated fertilizer and spray guns are devices in which chemicals are dissolved in water, and the water pressure is used to spread the fertilizer or insecticide solution. These constitute inter-connections and should be designed with air break provisions.

6. Cross-Connections With Dual Supplies

Dual supplies are divided into two groups: those which are polluted and which are ordinarily used only for fire protection and industrial purposes; and those which are safe and which are used as auxiliary and commercial supplies as well as for fire protection.

In general, city ordinances reflect the practices recommended by the state boards of health. There is no uniformity in the methods of classifying or of protecting against cross-connections from dual supplies. The mechanical devices relied upon are far inferior to the most recent protective devices for plumbing fixtures. There must be a complete revision of present practices based on what is being accomplished in the plumbing field. Since the danger of cross-connections from dual supplies is the greatest menace to the safety of water supplies, additional mechanical means for protection are certain to be developed.

a. Polluted Dual Supplies: Many cities, e.g., Detroit, Mich. (em), and Sacramento, Calif. (en), allow double check valve installations on dual supplies, provided approval by the health, plumbing, or water department is obtained. The subject of polluted dual supplies is discussed in Part A of this section, under state board of health requirements.

Bismarck, N. D. (eo), requires that buildings using private supplies remove a section of pipe at the meter service. This pipe cannot be reinstalled without notification to the water and health departments. Detroit, Mich. (ep), and Madison, Wis. (eq), prohibit any connection to a questionable supply, and require that the distribution system for the impure supply be painted red and be properly labeled at frequent intervals. Seattle, Wash. (er), permits cross-connections under special permission which is revocable by the water superintendent at any time.

b. Safe Dual Supplies: The State of New Hampshire Code (es) and many city ordinances such as those of Washington, D. C. (et), Duluth, Minn. (eu), Louisville, Ky. (dy), St. Louis, Mo. (ev), Springfield, Mass. (ew), Syracuse, N. Y. (ex), and Tampa, Fla. (ey), prohibit all cross-connections, even between safe dual supplies and the domestic water system. Memphis, Tenn. (ez), as well as other cities, under similar circumstances, allows cross-connections with safe dual supplies, but only when the private supplies are under adequate laboratory supervision and when they are derived from the same underground source supplying the city wells.

c. Conclusion: Cross-connections should be tolerated only when they are made between similar waters under laboratory control. Waters of questionable purity, as well as those dissimilar in chemical makeup, might permissibly be connected with the domestic supply when suitable back-flow and back-siphonage preventing devices are

installed. In this provision, questionable purity might be considered as referring to waters averaging up to 50 *Esch. coli* per ml. Waters severely contaminated with sewage should under no circumstances be cross-connected; and precautions to paint the impure pipes a characteristic color and to label them properly should be taken. The use of removable nipples, as at St. Paul, Minn. (fa, fb), and combination faucets, as at Bismarck, N. D. (fc), and Madison, Wis. (i), as well as the installation of swing connections, should not be allowed, since such fixtures make possible the backflow of polluted water into the water system when they are re-connected.

7. Pumps and Pressure-Producing Devices on Water Lines

Pumps and pressure-producing devices, when installed directly on water lines—whether used to supply roof tanks or circulating systems for cooling, or for hot water, industrial uses, ice water, condensers or refrigerators, yard sprinklers, irrigation reservoirs, fountains, falls, or soap dispensing lines—constitute inter-connections which, when not operating, may permit "used" water to gain access to the water system.

Duluth, Minn. (fd), and Louisville, Ky. (fe), prohibit the direct connection of service pumps to domestic water lines, requiring the use of an intervening vessel. Wilmington, Del. (ff), is the only city which provides for the protection of pumps and hydrants from surface water contamination and which prohibits the connection of "drip lines" to sewers.

Hydraulic elevators, not connected to a sewer, are still a problem. Water used in a hydraulic elevator is warm, contains hydrocarbons to lessen viscosity, and is used under high pressures. Direct connections to drinking water lines should therefore not be made. The New Hampshire State Code (af) and the regulations of three cities, Madison, Wis. (ae), St. Louis, Mo. (fg), and Springfield, Mass. (fh), include provisions against this danger.

Back-wash lines to swimming pool pumps appear to be covered only by general ordinance provisions, but specific mention should be made to prohibit any connection to swimming pools through pump suctions or discharges, other than through an intervening vessel.

Hydraulic press connections are prohibited by Madison, Wis. (ae).

Where pumps and pressure-producing devices are concerned, the consensus of opinion is that supply lines to all such devices should

be through an intervening tank. There is considerable need for general revision of existing practice in this matter.

8. Vacuum Pumps and Vacuum-Producing Devices

Vacuum pumps inter-connected with water supplies are employed in de-aerators, clothes dampening devices, sewage sludge and industrial vacuum filters, morticians' equipment, steam plant condensers, and hydraulic vacuum cleaners. Vacuum systems exist in heating systems, steam return lines, sterilizers, autoclaves and boilers. There should be no physical connection between water lines and vacuum systems because of the siphonic action which inevitably results.

Only one city, El Paso, Tex. (fi), prohibits direct connections to vacuum cleaning equipment.

It would appear logical to recommend the prohibition of all direct connections to vacuum pumps, vacuum cleaning devices or systems, and steam generating units, unless intervening vessels are used.

9. Steam Generating Units

Connections to steam generating units fall naturally into two divisions—first, sterilizers and autoclaves, used in hospitals and laboratories, and second, "boilers." In either case, steam pressure may exceed water pressure at critical periods. The vacuums created when steam condenses are the equivalent of reversed explosions, causing a rush of the nearest liquid to replace them. Autoclaves, pressure cookers, coffee urns, food processing cookers, retorts, stills, steam return systems, and instrument sterilizers are included in this type of connection.

The cities which outlaw direct service to sterilizers include Bismarck, N. D. (fj), Chicago, Ill. (fk), Newark, N. J. (fl), New Orleans, La. (fm), New York, N. Y. (fn), Oklahoma City, Okla. (fo), and Providence, R. I. (el).

Direct boiler connections are more and more being prohibited by new plumbing codes. The earliest protection was that of installing check valves with relief valves on the discharge side, as at Bismarck, N. D. (fp, fq). Another development in this field is illustrated by the Sioux City, Iowa, ordinance (fr) which outlaws actual back-flow of hot water into the system, even from hot water tanks. Five cities—Albany, N. Y. (fs), El Paso, Tex. (ab), Louisville, Ky. (ft), St. Paul. Minn, (dx), and Santa Barbara, Calif.

(fu)—have gone all the way, prohibiting direct services to boilers under any circumstances. It has already been noted that the states of Kentucky, Maine, New Hampshire and North Dakota prohibit direct connections to boilers.

The boards of mechanical engineers and boiler insurance inspectors throughout the country require alternative methods of filling boilers. Possible methods are gravity-feed tanks with air-gap water line inlets, float-operated tanks with pumps, steam injectors, or hand pumps. Connection requirements apply equally to high and low pressure boilers.

It would seem possible to install mechanical devices to protect boilers, provided they include relief at pressures higher than domestic water pressure, a broken connection to atmosphere, when not in use, and provision to satisfy vacuums on the domestic water lines.

10. Fire Service Connections

Fire hydrants located on the water distribution system and siamese connections on private fire sprinkling systems exist for the two-fold purpose of obtaining water for fire fighting purposes and of pumping a dual supply into the domestic water system or private sprinkling system. The fire sprinkling systems are usually equipped with a gate valve and detector check valve to maintain pressure in the private system, allowing any leakage to back up into the domestic water system. Along water fronts, connections are retained purposely so that fire boats may pump directly into the water system.

Many cities have ordinances prohibiting any cross-connections with impure sources, even for fire protection, e.g., Baltimore, Md. (fv), Little Rock, Ark. (fw), Memphis, Tenn. (ez), Oklahoma City, Okla. (fx), and St. Paul, Minn. (fy, fz, ga).

New York State (24) permits chlorinators on emergency fire supplies. In a number of instances, special non-freezing compounds are added to the water in the fire sprinkling system to prevent damage in cold weather. So far as is known, there are no regulations prohibiting this type of use. These fire protection cross-connections, however, should be protected by strict rules and regulations governing the action of fire fighting crews.

Fire departments using part or all of the private domestic water piping system should not pump out flooded basements.

All private fire sprinkling systems should be mechanically protected against back-flow. No sewage or polluted waters should be

pumped into the water system unless approval has been received from both the health and water departments. Private fire systems should be considered as dual supplies as covered by Part 6 of this section.

11. Piping in Old Buildings

Although numerous cities have good regulations against many types of inter-connections, none has 100 per cent coverage. Plumbing ordinances are rarely retroactive and since most ordinances are no more than five years old, it is apparent that considerable faulty plumbing and dangerous types of inter-connections still exist.

The water department is interested in preventing back-flow of water on private premises, where inter-connections exist, from entering the piping system and subsequently being served to other consumers. Theoretically, some types of connections exist on practically every service; but, from the practical standpoint, some are more dangerous than others. Special mechanical protection at the meter should be provided to prevent back-flow from all downtown office buildings, restaurants, oil refineries, chemical plants, industrial plants, food preparation establishments, hotels, apartments, where connections, as outlined above, might exist and to endeavor thereby to protect the greatest number of people. It is recommended that all such services be properly protected against back-flow by suitable mechanical devices.

D. Water Department Provisions on Connection Protection

1. Right of Water Department to Make Inspections

Plumbing inspectors usually have no authority to inspect old installations and so are limited in retroactive clean-ups. Health department inspectors have broad powers and probably are the most effective in eliminating bad conditions. In many cities, however, their personnel does not include sanitary engineers.

There has been a growing need for permitting water department inspectors to inspect private property out of sheer desperation in the endeavor to remove existing dangerous connections and to supply safe water. In the survey, it was found that three cities—Memphis, Tenn. (gb), Portland, Ore. (gc), and Tampa, Fla. (gd)—specifically authorize their water departments to make inspections on private property.

2. Right to Shut Off Water

Only two cities—Bismarck, N. Dak. (ge), and El Paso, Tex. (gf)—delegate to the health department the responsibility for shutting off of a water supply because of cross-connections. Augusta, Ga. (gg), Duluth, Minn. (gh), Kansas City, Mo. (gi), Louisville, Ky. (gj), Memphis, Tenn. (gk), Oklahoma City, Okla. (gl), Santa Barbara, Calif. (gm), Seattle, Wash. (gn), Springfield, Mass. (go), and Tampa, Fla. (gp) delegate this responsibility outright to the water department.

3. Control of Service at Time of Issuance

An excellent time to acquaint consumers with cross-connection, inter-connection and back-flow control measures is at the time they sign up for new service. The water department may then require them to sign a statement to the effect that no cross-connections or inter-connections (in the broadest sense) shall be permitted to exist on their premises. Cities which require such a provision include Denver, Colo. (gq), Duluth, Minn. (gr), Memphis, Tenn. (gs), Nashville, Tenn. (gt), Oklahoma City, Okla. (gu), San Francisco, Calif. (gv), and Seattle, Wash. (gw).

4. Testing of Water Piping Pressures, Water Devices and Plumbing Fixtures

Testing for back-flow and back-siphonage conditions is divided into three categories. First, it is desirable to install pressure and vacuum recording gages on all private piping systems with all water services in a reasonable maximum use, to test the adequacy of any private piping system. Except for occasional investigations, this phase of examining connections has hardly been touched. In fact, very few water departments are at present equipped to carry out such investigations. The second category covers the testing of water devices such as auto shampoo equipment, fertilizer applicators, and colonic irrigators, which involve many factors not found in the usual plumbing fixture. So far, little or no legislation has been passed to cover these points. The third class involves the testing of plumbing fixtures; and it is in this field that most of the testing has been done.

Testing of plumbing fixtures is divided into two phases. First is the quick test of setting up the fixture with a water supply and a vacuum source, so that observations can be made under all types of back-flow and back-siphonage conditions. At this stage the pro-

cedure is primarily a testing of principles used and a determination of safety factors. The second phase is a long-time or accelerated test to determine durability and reliability of moving and operating parts against corrosion and deposition and to discover the reaction of materials passing the device. There is great need at present for adequate specifications covering the principles to be employed in protection against connections and in the testing procedures just discussed.

Chicago, Detroit, El Paso, and Los Angeles maintain municipal laboratories for back-siphonage testing. At the present time there is little or no co-ordination among these cities in the matter of agreement on test requirements. A number of reliable commercial research laboratories are carrying on excellent development work. Some private laboratories receive fees to develop devices and do not hold an official test until there is assurance that the devices will pass their final tests, at which time information is accepted as final by most cities and states.

E. Conclusions

In the above discussion about 150 different types of cross-connections and inter-connections have been mentioned. Except for coverage in general terms, however, only 78 cities, or approximately 52 per cent of those answering the questionnaire, specifically mention one or more types in their regulations. The most outstanding progress has been made at El Paso, Tex., where about 14 per cent of the 150 types which have been discussed are covered specifically in ordinances. Following El Paso in the comprehensiveness of their laws are: New York, N. Y., Bismarck, N. D., the various cities of New Hampshire which use the state code, Detroit, Mich., and Madison, Wis. The 78 cities which have some provisions against back-flow and back-siphonage represent 29 states from all sections of the nation. It is apparent that little consistency prevails and that some uniform program should be universally adopted.

V. Mechanical Protective Devices

A. General Principles of Mechanical Protection

An analysis of the extent of protection which various mechanical devices may safely be called upon to accomplish is of prime importance in determining the general principles of protection. It is easy enough to insist dogmatically that no mechanical devices should

be connected between domestic water lines and lines carrying such water after it has been used, altered, or wasted. That such connections have come to stay is apparent.

The author was formerly convinced that the air-gap method of protection should be universally applied, because of the inevitable ultimate failure of mechanical devices, but his experience has led to a disillusionment concerning the real effectiveness of such a policy. In oil field protection, for instance, it has been the policy of the Los Angeles Bureau of Water Works and Supply to require water users to install at the property line a tank into which there was a free overhead discharge. Yet, in practically every instance, inspectors have later found cleverly concealed bypasses. On one oil well lease the operator even went so far as to install a bypass inside the tank at the float inlet and to keep a dummy pump operating to make it appear that the air gap protection was actually in effect.

In his experience the author has found many instances where building owners and maintenance men re-establish inter-connections around the air gap protection, make sewer connections to lines formerly carrying harmless wastes, and cut directly into overhead lines to tanks for new uses. What guarantee there is that surreptitious connections will not be made to lines once presumably made safe is a moot question. The author contends that the unpredictability of the human element is on a par with the uncertainty of mechanical devices, and that proper protection involves a reasonable coverage for both uncertainties.

B. Protective Devices in Present Practice

1. Air Relief Valves

Air relief valves have been used for many years to protect large mains from collapsing and are reliable down to 2-inch sizes. They have been installed in hillside locations to admit air to and to eject it from low pressure zones.

2. Stable Flush Valves and Integral Vacuum Breakers

Stable flush valves are those in which the main seat remains closed automatically when a vacuum is applied. Piston type flush valves may be equipped with double cup leathers and the diaphragm type may be provided with a weight sufficient to overcome the vacuum lift. In either event, the auxiliary bypass opens when the vacuum is applied. The function of the vacuum breaker is to satisfy

the auxiliary by-pass requirement so that the vacuum can neither lift water from a flooded closet nor cause a considerable amount of leakage past the main seat. Ordinarily a leak of one gallon per minute causes sufficient agitation in the bowl contents to indicate a need for repair, and such a leak, if continued, usually increases the consumer's water bill about $5 per month. These two factors tend to force reasonably safe operating action of the flush valves. The vacuum breakers should be corrosion-proof; should contain a minimum number of moving parts, all of which function each time the flush valve operates; should not spit water; and should be so designed to defeat plugging or mutilation. Every flush valve should be located 6 in. above the overflow level of the device to which it is connected.

3. Vacuum Breakers

A large number of vacuum breakers, ranging from small peanut whistles to large check valves opening to atmosphere, have flooded the market. For sizes less than 2 in., there has been difficulty in designing types which will not spit water and which will not freeze up when installed for continuous use under pressure. Several types which may solve these difficulties are now being developed. Their design is based on a slight continuous movement of the main seat. Satisfactory vacuum breakers for use below control valves, feeding fixtures or devices under low or zero pressure are numerous. Such valves, if located with a drop leg (2 ft. or greater) below them, automatically change their moving parts with the opening and closing of the main valve, even when a vacuum is not applied. They are, however, never sufficient in size to satisfy large vacuums, so check valves between the stop valve and the vacuum breaker or combined check and stop valves should be provided to restrict the vacuum which reaches the vacuum breaker. The check valve is easily inspected for leakage as it will be evident when the stop valve is closed. These types of check and vacuum breakers have proved satisfactory over several years of observation.

4. Types of Special Valves

a. Operating Functions: Certain valves now available possess the following operating functions:

(1) *Broken Connection:* A port equal in diameter to the connected pipe is manually opened; and the inlet line (stopped

when the valve is shut or during use) is automatically opened when it is stopped if the inlet pressure is zero or less. Thus, a broken connection exists under back-siphonage conditions.

(*2*) *Back-Flow:* Back-flow is normally prevented by a check valve, the leakage of which can be determined by inspection.

(*3*) *Repairs:* Repairs can be made by shutting the valves on both sides of the fixture.

(*4*) *Pressure Relief:* Relief of all excess private pressure, of 5 lb. per sq.in. or more, which passes a leaky check valve is provided by a device integrally constructed and which remains seated at all times, under reverse flow or under static conditions. All parts of the pressure-releasing device are independent of all ports and parts of the vacuum breaking device.

(*5*) *Vacuum Breaker:* If a vacuum is produced on the city side, a check prevents full action on the valve and air is admitted to destroy the residual effect of the vacuum.

b. Development: One of these special valves, the E-C Valve, has been developed over a period of six years, and for the past two years all internal parts have been protected against corrosion, made to move more freely, and machined and manufactured with greater care, and "hunting" has been controlled. Several hundred have been adequately tested in the field. Its competitor, the Empire Valve has not yet appeared on a production basis; and another valve of similar character is still in the stage of development.

It is to be noted that the differential to which these valves can be set is less than the normal pressure fluctuation in public and private water systems and that a check valve leaking 1 g.p.m. at a pressure of 20 lb. per sq.in. leaks less than 6 per cent of that amount at a pressure of 5 lb. per sq. in. It is obvious from such data that such valves will meet extremely exacting conditions.

5. Other Available Valves

Other valves accomplish essentially the same functions as those mentioned in the preceding paragraphs, but are not as reliable in preventing back-flow. These valves break at a differential of 3 to 4 lb. per sq.in., whereas the former, although set to relieve at that differential when the check valve is holding, do not break until the excess pressure reaches 20 lb. per sq.in. when the check valve reaches a leak rate of 1 g.p.m.

These other valves have not been put on a production basis but

two have undergone three months' observation, during which no particular effort was made to test durability, freedom of moving parts, and resistance against corrosion. Their chief advantage is economy and suitability for certain types of connections.

It is to be noted that a leak in a check valve at a pressure differential of 20 lb. per sq.in. frequently exists between the public and private piping systems; and since the leakage past the check valves can be seen, this type of protection may be ample to safeguard several types of connections.

6. Swing Connections

A swing connection is usually a piece of pipe whereby a private system may be connected to either the city or the dual supply, but not to both at one time. There is no provision to prevent back-flow of the dual supply in the private system except a check which may start leaking when the swing over to the city system is made. Furthermore, there is no provision to satisfy vacuum formations.

7. Insertion of Nipples

Nipples are used for temporary connections between domestic lines and fire pumps having polluted sources. Such installations should (as in New York City) include automatic chlorination at the fire pump; and after the fire, the domestic system should be drained and disinfected.

8. Water Columns 34 Feet in Depth

A water column 34 ft. deep constitutes a positive vacuum breaker when its bottom is kept flooded with water over the inlet to the private water piping system. It does not, however, constitute protection against back-flow from excess property pressure. If the private system is drained, the pollution of air and spray from toilet rim outlets may result. There are, however, a few special cases where such a device may successfully be used.

9. Double Check Valves Equipped With Testing Cocks, Pressure Gages and Shut-Off Valves

A double check valve that is equipped with testing cocks, pressure gages and shut-off valves constitutes the "Factory Mutual" type of assembly now permitted by many state boards of health. Check valves, however, no matter how glorified, constitute protection *only*

when they do not leak. Even with the inclusion of weighted check valves and strainers on both the city and private sides, particles of gravel, lead, cement, oakum, fish bones and sticks have been found under leaking valves. In Los Angeles, double check valves are frequently found leaking and so are considered to give inadequate protection. Although internal clearances prevent flappers from becoming stuck, as in the earlier and cruder check valves, possible leaks from natural causes condemn them as positive methods of protection.

Most states require inspection of valves at from one to twelve month intervals; but since polluted water could back into domestic water systems many days before inspections revealed such conditions, the present double check valves cannot be considered fully satisfactory.

Since so many installations (hundreds in each large city) have already been made, some method of further protection should be adopted. For instance, such installations should now include the addition of a small device to relieve and waste all water creating an excess pressure of 5 lb. per sq.in. (on the private system) which passes supposedly tight check valves, and should be equipped with an indicator to give warning of such leakage. It is to be noted that the actual volume of leakage at low pressure differentials is small, but that it increases as the square of the head for higher differentials. There should also be a break to atmosphere when water is not being used, a development now being given attention. Even with these added protective devices, however, there is no provision for vacuum breaking, although the pressure relief device will reduce the private pressure to zero.

In the future, to be consistent with other types of protection, pressure valves, vacuum breakers or air inlet valves for large installations should be added to the city side of all double check valve systems.

10. Air Gap Protection

Air gap protection includes raising all inlets above the overflow level of fixtures, tanks or reservoirs, as well as supplying unsafe sources with tank water having a free overhead inlet. To be effective, the line from the meter to the tank should be exposed and painted a characteristic color; be constructed of different material than either water or sewer lines in the same building; or be encased in concrete so that "dishonest" connections may be minimized.

In some instances the air gap protection may be between the fixture and the sewer, in which case the water inlet should be protected with a check valve and vacuum breaker.

VI. Principles and Protective Devices Involved in Connection Protection

To protect domestic water systems against back-flow and back-siphonage and against pollution from dual supplies, it is necessary to: (1) reduce conditions producing back-flow and back-siphonage to a minimum; (2) outlaw connections which might positively render the water supply bacteriologically unsafe and chemically poisonous; (3) rely on mechanical devices for protection for less dangerous conditions, as well as those which might affect the water supply only aesthetically; and (4) secure correct plumbing installations of proper fixtures. In the case of plumbing installations, only those mechanical devices which have been tested for adequacy of design, material of construction, and durability, as determined by an accelerated operation test, should be used. Such testing should, of course, be done by impartial testing laboratories.

Appropriate state laws, municipal ordinances and water department regulations should, for comprehensive protection, cover all of the following items: (1) elimination of distribution hazards and enforcement of measures in street main operation, to reduce back-flow and back-siphonage conditions to a minimum; (2) prohibition of connections with dual water supplies, and adequate protection where secondary water supplies are cross-connected; (3) enforcement of proper water piping ordinances to minimize back-flow and back-siphonage occurrences in water piping systems; (4) regulations of water supply usages and chemical treatment, together with use of protective devices and proper plumbing, to prevent pollution of the water supply by back-flow or back-siphonage from used or altered water; (5) elimination of direct inter-connections with sewers and tanks containing poisonous chemicals; (6) protection of inter-connections to strictly waste lines which have air breaks to sewage sumps; (7) prohibition of direct connections with fixtures activated with substances other than water or sewage, but which have motive power to cause back-flow; (8) selection of plumbing fixtures free of inter-connection difficulties; (9) protection of plumbing fixtures against back-siphonage; and (10) prevention of direct connections to steam boilers.

A. Control of Back-Flow and Back-Siphonage Conditions

Since low pressure and partial vacuums in the water distribution system are the first causes of back-flow and back-siphonage conditions, the first line of defense is the adoption of measures covering design, construction and operation of both public and private water piping systems which will promote the maintenance of as uniform pressure as possible. Conversely, the control of all devices or fixtures which tend to build up pressure or vacuum conditions on water lines will also prevent creation of back-flow conditions. Regulations for the safe delivery of water should take the following items into consideration.

1. Street Mains

a. Pressure Variations: The street distribution system should be so designed that the minimum hourly pressure variation will not be greater than 20 lb. per sq.in., and that the pressure variation at any point in the distribution system will not for more than a minute exceed an additional 10 lb. per sq.in. variation of the mean daily pressure.

b. Capacity: Water lines should be designed liberally as to size; and distribution zones should be laid out with pressure requirements foremost.

c. Repairs: Whenever a main is to be shut off for repairs or for the connection of a new service, all services should be shut off at the property line while pressure is on. The consumer should then be given notice concerning the length of the shut-off period and should be warned of danger of overheating water heaters. Even under these circumstances, the mains should be drained slowly, allowing air from a sufficient number of fire hydrants to replace water in order to prevent the formation of partial vacuums.

d. Valve Operation: There should be strict rules regarding the manipulation of valves, even for flushing purposes, so that consumers are not unintentionally deprived of pressure by someone shutting off the wrong valve.

e. Disinfection: Water from open trenches should not be allowed to drain into the water pipe. Any repair to water lines should be followed by adequate disinfection.

f. Shut-Off Valves: Shut-off valves in street lines and building piping systems should be so located that drainage of lines will not

cause back-siphonage on services or fixtures. This can be accomplished by shutting the valve controlling pressure; opening a fire hydrant or an air inlet at the highest point in the line to be drained; and then opening the drain for slow draining.

g. Sanitary Hazards: The distribution system should be designed free of all sanitary hazards.

h. Sewer Manholes: Water lines should not be located through sewer manholes.

i. Trenches: Water lines and sewer lines should not be laid in the same trench or cross each other unless a mat of concrete or an adequate compacted earth layer separates them. The Minnesota State requirements should be followed in this respect.

j. Vacuums: All vacuums in the distribution system should be dissipated promptly by mechanical devices to reduce vacuum effects on private property to a minimum. Fundamentally, a utility receiving compensation for supplying water under pressure should under no circumstances permit the formation of a partial vacuum in the supply, particularly since it spins the meter backwards. If such a vacuum is formed, an alert property owner, by opening as many faucets as possible, might materially decrease his water bill.

k. Vacuum Breakers: All distribution lines 4 in. or larger in size should be equipped with a valve and vacuum breaker of the type used to admit air on large transmission lines. These should be located at least every 1,000 ft. horizontally and for each 15 ft. difference in elevation. Such air inlets should be on the lower side of a valve so that when the valve is closed manually it will be located on the upper end of its closed system. Air valves should be so located as to take in safe and clean air. Partial vacuums in the distribution system are severe when mains break or when they are drained in zones having mains 15 to 30 ft. higher than at the point of draining. The larger the main creating the vacuum, the greater is its capacity. It is essential to prevent the formation of such vacuums.

2. Private Piping Systems

Considerable improvement can be made in the maintenance of adequate pressure on private water piping systems. Following are some suggestions which should be heeded in the accomplishment of this purpose.

a. Piping Codes: There should be an adequate standard water piping code which should cover: (1) use of proposed services for homes, apartments, public buildings, food preparation and eating places, hotels, commercial establishments and industrial plants; (2) determination of the maximum quantity of water required, by totaling the capacities of all fixtures and assuming that a certain percentage are being used simultaneously; (3) taking into account the elevations and lengths of service lines in arriving at a determination of the size of meter and the size of service and branch lines which will result in a pressure drop, including that at the meter or at any fixtures, not to exceed 10 lb. per sq.in.; and (4) cover arrangement of risers and storage tanks to reduce pressure variations to a minimum.

b. Pipe Installation: Water lines should be installed on an uphill grade to all fixtures to facilitate draining without either formation of air pockets or creation of secondary siphons.

c. Meters and Valves: The minimum size of meters should be $\frac{3}{4}$ in. for ordinary uses,[9] and larger where flush valves are used. It is realized that such a basis of design results in the use of larger meters than are ordinarily selected and in the installation of much larger lines supplying flush valves than is the usual practice; but a loss of 10 lb. per sq.in. in the private system together with a loss 10 lb. per sq.in. in the pressure at the curb gives a total loss of 20 lb. per sq.in.. a potent factor in back-flow control where mechanical devices are used for cross-connection protection. For instance, a home requiring a flow of 35 g.p.m. might need a 1-inch instead of a $\frac{3}{4}$-inch meter, and a home equipped with three flush valves might require a 2-inch instead of the 1-inch meter which most of them try to use.

Globe shut-off valves and pressure regulating valves not properly adjusted cause excessive pressure losses. Gate valves should generally replace globe valves. Strainers, if allowed, should be cleaned regularly to prevent excessive losses.

d. Flow and Vacuums: It is generally advisable to design private water piping systems so that water flows normally in only one direction. Where storage tanks are required, they should be fed through lines separate from those supplying water fixtures. It is

[9] The comments of the author, as a sanitary engineer, upon the subject of the size of water meters are in conflict with the opinion of many engineers concerned with the distribution of water and the control of wastes. The relative merits of the two opinions will be appraised more easily as the understanding of the entire subject is increased.—*Editor*

not practical to relieve vacuums by devices installed on private premises unless 2-inch or larger pipe is used, but if the partial vacuums in the street mains are corrected by air inlet valves on the public distribution system, it is not necessary to provide such facilities on the private system.

B. Protection of Cross-Connections and Inter-Connections

The four general principles of protection against the dangers involved in cross-connections and inter-connections (including the causes of back-flow and back-siphonage), in order of the importance of the dangers which they eliminate, are:

1. Use of Air Gaps

The use of a positive air gap for all connections to sewers subject to pressure back-flow, to devices and containers holding poisonous chemicals, to ammonia-gas neutralizers, and to sources of either pressure or vacuum systems, until such time as more adequate mechanical devices have been developed, is of primary importance. This classification includes: closed connections to sewers at sewer flush tanks; overflows from cold- and hot-water tanks and reservoirs; cooling water or jacket lines; direct flushing lines; drains of all types; backwash lines; sewage pump priming lines; sewage wet-well or meter float lines; services to hydraulic elevators; sewer and water lines in the same trench; water lines laid through manholes; hose connections into sewage fixtures or containers; sewer lines over water or ice tanks; the water-pressure actuated "plumber's friend"; various water- and sewer-connected devices, such as sewage ejectors, bilge pumps, blow-offs, vacuum filters, pump sealing rings, sewage chlorinators and ozonators; tanks or lines containing cyanides and chromium and silver salts; barium compounds and glucosides containing heavy metals; polluted dual supplies; connections to carbon dioxide, compressed air and liquid substances foreign to water; and direct connections to pressure or vacuum pumps or systems including hydraulic elevators, hydraulic presses and various types of vacuum-using devices (see Section IV C, items: 1a, b, c, d; 4a; 5; 6a; 7; and 8).

In addition, where possible, it is advisable to raise all submerged inlets to tanks and fixtures, where such action does not interfere with operations, and to adopt fixtures of the latest types which are equipped with raised inlets.

2. Mechanical Protection of Inter-Connections to Sewers and Drains

The use of mechanical devices to protect against back-flow and back-siphonage into water lines connected to sewers and drains, through devices or fixtures where sewage overflows exist at the fixture inlet, constitutes another important measure involved in connection protection. The mechanical device in this case should be a check valve above the fixture overflow level, so installed that leakage past the check valve can be seen and that an integral air inlet may be provided on its discharge side. The principle involves the use of either a stable flush valve equipped with a vacuum breaker or a check valve and vacuum breaker, and applies individually to all flush valves and submerged inlets to tanks, devices, and fixtures (see Section IV C, items: 2a, b, c; 3; and 4b, d, e).

This method of protection is very effective on certain auto massaging devices which use soap, water and air in combination. In such devices, an inter-connection between the soap and water supplies would spoil the rinse, and one between the water and air fixtures would spoil the wash; hence, a ball check equipped with an adequate air inlet and located in the water port at the nozzle provides essential protection.

3. Mechanical Protection of Cross-Connections to Suspiciously Contaminated Sources

The use of mechanical devices to prevent back-flow from suspiciously contaminated sources, and from used or altered water which is aesthetically undesirable, to lines supplying groups of flush valves or submerged inlets represents still another principle of connection protection. This principle involves cross-connections to lines feeding storage reservoirs and tanks; to water supplies of miscellaneous uses; to suspiciously contaminated as well as safe dual supplies; to fire service connections; to services supplying siamese connections; to services to buildings frequented by the public, where dangerous cross-connections are known to exist; and also to groups of lines to fixtures or containers requiring mechanical protection (see Section IV C, items: 2a, b; 3; 4c; 6a, b; 10; and 11).

This type of protection covers services to industries and oil fields where dangerous types of connections are invariably made. The mechanical devices which meet its requirements are: "E-C Valves" or their equivalent, "Empire Valves" or their equivalent, and a

double check valve installation with such additional protection as a pressure relief valve and a vacuum breaker. The first two devices appear suitable for services of from 1 to 4 in. in size, and the other for the larger (8 to 12 in.) services.

4. Mechanical Protection of Inter-Connections to Less Dangerous Fixtures

Finally, the use of a mechanical device for less dangerous connections, but where back-flow should, nevertheless, be prevented also deserves consideration. The group of fixtures, to which such protection refers, includes special waste fixtures having submerged inlets; steam generating units, such as sterilizers, autoclaves and high and low pressure boilers; and house services where inter-connections other than directly to sewers exist (see Section IV C, items: 2a, b; 3; 9; and 11). The mechanical devices suitable for this protection include "Economy Valves" or their equivalent and "Ellis Valves" or their equivalent. Neither of these types of valves has yet been put on a production basis, but a few have been installed as a part of a program of development.

C. Addition of Chemicals

No poisonous chemicals should ever be added to any safe water lines; and only such non-poisonous ones as are essential to necessary and recognized water treatment practices should be—and those only by licensed operators under water department control.

The addition of all chemicals should be controlled by representatives of the water department and, in some instances, under joint approval of water and health departments, depending upon local ordinances. Main treatment plants for the entire city supply should be allowed to use the generally accepted materials to correct color, turbidity, hardness, and pH. Chlorine and ammonia may be used for disinfection. Base-exchange zeolites, with salt for their regeneration, and hydrogen and hydroxyl zeolites, with acid and alkali regenerating agents, may both be used for altering the chemical constituents of a water, even to the extent of removing either its positive or negative ions. In all instances, however, such additions should be made under the direct supervision of water department representatives.

On private premises there should be strict control of the chemicals which may be added to water and they should be added only

by employees of licensed firms and through devices approved by water department and health department officials jointly. These rules should be applied to the water supplies used for industrial purposes as well as those for swimming pools, wherever such supplies are directly connected to the public water system. The addition, for corrosion control purposes, of metallic silicates and silicates containing purgative or poisonous constituents to hot water systems which may be used for drinking purposes should be absolutely prohibited by law. Any hotel, apartment house or office building which uses sodium silicate for corrosion control should be required to label as dangerous all taps receiving such water, and to advise persons against drinking it. All hotels, apartment houses and office buildings which soften water to zero hardness should also be required to mix that water with untreated water to obtain a residual hardness of at least 5 p.p.m.

VII. Recommendations

It is recommended:

First, that all state health departments adopt uniform, general regulations to minimize the causes of back-flow and back-siphonage, as well as to control cross-connections and inter-connections.

Second, that all states adopt a state water-use code covering specifically the entire program of cross-connections, inter-connections and back-flow control as it applies to:

1. Water distribution and sewer design engineers
2. Water main repairmen and operators
3. Architects who design private piping systems
4. Boiler room, steam plant, and water treatment engineers
5. Journeymen and master plumbers
6. Inspectors of health, water, buildings, plumbing, boilers and elevators
7. Fire insurance inspectors and fire departments
8. Approval of allowed plumbing fixtures and water-using devices.

Such a code should cover every possible type of connection, using uniform principles of protection consistent with the dangers involved, and covering the following points:

1. Design of public and private water distribution systems so that normal operating pressure variations do not exceed a limited amount in keeping with safe practice

2. Installation of 2-inch vacuum breakers on city lines for every 1,000 ft. horizontal distance and for every 15 ft. differences in elevation

3. Shut-off of every house service when mains are drained for repairs

4. Prohibition of the laying of water lines and sewer lines in the same trench

5. Use of a $\frac{3}{4}$-inch meter as the minimum size and installation of gate valves instead of globe valves for shut-offs[10]

6. Adoption of adequate water piping specifications and specifications for uses to which water may safely be put.

Third, that all cities assume jurisdiction over "water piping" under "plumbing" laws and that they modify their various ordinances to conform as nearly as possible to a suggested ideal code, including:

1. Measures to reduce back-flow to a minimum, both in the public and private water piping systems, from the standpoint of installation and operating procedures

2. Elimination of all dangerous pressure connections to sewers, dangerously contaminated dual supplies, and water supplies rendered chemically poisonous

3. Use of three grades of mechanical protective principles, according to the degree of danger which the various types of connections involve, as follows:

a. Check valves with vacuum breakers or stable flush valves with vacuum breakers, for flush valve and plumbing fixture protection

b. A check valve, with a special valve incorporating pressure relief, vacuum breaking and air opening to atmosphere, to be used for less dangerous connections, such as: suspiciously contaminated dual supplies; used or altered water, aesthetically undesirable; fire services; private premises or special lines maintaining unprotected dangerous connections, with the valve so designed as to prevent back-flow whenever the private pressure is 5 lb. per sq.in. higher than the city supply, regardless of leakage past the first check valve

c. A simpler device than that just mentioned, for the least dangerous connections, including protection from lines supplying

[10] See footnote 9, page 450.

submerged inlets to fixtures connected to special waste lines and to steam generating units, such as sterilizers, autoclaves and boilers, and designed to prevent back-flow. (The pressure relief valve is less effective than the valve described in Part *b*, because, as the leak in the main check valve increases to 1 g.p.m., the relief device does not function until the pressure differential reaches 20 lb. per sq.in.)

Fourth, that the water department be given authority to protect its services, to make inspections of private premises for location of dangerous connections, to test protective devices, and to discontinue service when consumers fail to observe city ordinances and state regulations, all in co-operation with its health and building departments.

Fifth, that a program to eliminate existing cross-connections and inter-connections be instituted, using educational means rather than legal threats, and emphasizing the fact that it is to the interests of all that the future spread of water-borne disease through such connections be reduced to a minimum.

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For Appendix see following page.

Appendix

Quotations From City Ordinances and Water Department Regulations

The terminology used in these quotations is that employed by the legislative bodies which enacted them and so does not necessarily follow the present accepted definitions of cross-connections, inter-connections and back-flow as used in this paper.

Direct Connections to Sewers

(*a*) "No water pipe shall be connected directly into a closed sewer system." (Kansas City, Mo., Water Dept. Ordinance and Rules, Rule 28, Direct Water Connections to Sewer Prohibited)

(*b*) "Water Pipes: No part of any piping system carrying water for human consumption shall have a direct connection with any wastage pipe." (Minneapolis, Minn., Plumbing Ordinance, Sub-Sec. 17.1)

(*c*) No cross-connection shall be permitted between a distribution system or water supply for drinking and domestic purposes and a drainage system, soil or waste pipe, so as to permit or make possible the back-flow of sewerage or waste into the water supply system." (Mobile, Ala., Water Works Dept., Sanitary Code, Sec. 5, Cross-Connections (b))

(*d*) "A cross-connection between a potable water supply pipe and a foreign water supply pipe is prohibited, nor shall any emptying pipe, or pipe wasting potable water after passing through an air cooling system, refrigerator system, hydraulic machine, or any similar pipe, be directly connected to any soil, waste or vent pipe, or any pipe connected therewith, or to any part of the drainage system of any building or premises." (Newark, N. J., Dept. of Health, Sec. 1039, Par. 2, Cross-Connections)

(*e*) "A connection between a drinking water supply and an unsafe water supply, or a connection between a water distribution pipe and a fixture installed in such a manner that unsafe water, waste or sewage may be drawn into the drinking water system." (Portland, Ore., Plumbing Code, Ord. No. 72217 (as amended), Sec. 215, Par. 5)

"No plumbing piping, plumbing fixture, appliance, apparatus or device shall be constructed, installed or repaired in any plumbing or drainage system in or for any building or premises in a manner which will allow or provide a cross-connection between the water supply and/or distributing system of the water supply used for drinking and/or domestic purposes and the waste or sewage disposal system, or make connection to or with any pipe or piping of a plumbing or drainage system, water system, building drain, soil or waste

pipe so as to cause contamination of the water supply, or make possible the back-flow of sewage, waste or fetid matter into the water supply system.

"The minimum required air gap between the orifice of a faucet and spill line of a fixture shall be as follows:

Basins	1 in.
Kitchen sinks and laundry trays	1½ in.
Bath tubs	2 in.

"All water supply outlets, which cannot be protected as outlined above shall be protected from back-flow or back-siphonage by the use of siphon breakers and siphon preventor stops or check valves.

"Only approved siphon breakers and siphon preventor stops shall be used." (Portland, Ore., Plumbing Code, Ord. No. 72217 (as amended), Part VII, Sec. 702)

(*f*) "Direct connections between sanitary system and water supply pipes are prohibited." (Syracuse, N. Y., Dept. of Health, Plumbing Code, Sec. XIV, II. Prohibited Connections)

(*g*) "The following conditions are also deemed to be potentially capable of contaminating the city water supply and are, therefore, hereby prohibited:

"Flush tanks in sewer lines." (Bismarck, N. D., Ord. No. 569, Plumbing Code, Sec. 18-311, C-9)

Direct Connections to Plumbing Systems

(*h*) "No plumbing fixture, device or construction shall hereafter be installed which will provide a cross-connection between a distributing system of water for drinking and domestic purposes and a drainage system soil or waste pipe so as to permit or make possible the back-flow of sewage or waste into the water supply system." (Baltimore, Md., Dept. of Health)

(*i*) "No direct plumbing fixture or pipe connection shall be made between any part of the water supply system and any part of the plumbing drainage system or impure water supply system except as provided for in part (d). (Madison, Wis., Protection From Back- Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03,(e))

"No faucet or combination faucet or like appliance so constructed as to form a cross-connection directly or indirectly between a safe drinking water and unsafe or questionable water supply shall be permitted." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03 (b))

(*j*) "When taking precautions to prevent injury to health through cross-connections, or inter-connections, in a plumbing system, a sound rule to apply is that physical connections of any nature between a water supply system and a plumbing fixture, a sewer or any non-potable substance, or any appurtenance using potable water, should not be made without an air gap or without a

safety device approved by a recognized testing laboratory." (Miami, Fla., Bul. #1 *in re* Plumbing Ordinance No. 1191)

(*k*) "No water supply pipe, or any emptying pipe, from any part of the water supply system shall be directly connected to the house sewer or house drain or to any soil, waste, or vent pipe." (Newark, N. J., Plumbing Ordinance, Sec. 1039, Water Supply to Plumbing Fixtures)

(*l*) "And all by-passed cross-connections which in the event of siphonage would permit the water distribution system to become contaminated by or with the contents of any plumbing fixture or plumbing waste pipe, are forbidden and not permitted to be installed." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, G)

(*m*) "No plumbing device, fixture, valve, fitting, apparatus, or plumbing connection of any kind that will provide a cross-connection between the Providence water supply and a sewerage system, or will permit or make possible by siphonage or back-flow of sewage or waste into the water system, shall be installed. Licensed plumbers will be held responsible for the observance of this rule and any violation thereof will subject the offender to the suspension or revocation of his license." (Providence, R. I., Water Works, Rules and Regulations)

(*n*) "No plumbing fixture, apparatus, device or construction shall be installed which will provide a cross-connection between a distributing system of water for drinking and domestic purposes and a drainage system, building drain, soil or waste pipe, so as to permit or make possible the back-flow of sewage or waste into the water supply system. No direct connection shall be made between the building water distribution service piping and the flush pipe or flush connection of a fixture which is connected to a building drain, soil or waste pipe." (Sacramento, Calif., Amendment to Plumbing Ordinance, Plumbing Fixtures Not to Connect Direct to Water Supply)

(*o*) "No plumbing fixture, device or construction shall be installed which will provide a cross-connection between the city supply and a drainage system, soil or waste pipe, so as to permit or make possible the back-flow of sewage or waste into the supply system." (St. Paul, Minn., Plumbing Code, Sec. 10, Cross-Connections)

Tank Overflow to Sewers

(*p*) "Water pipes from cafes, refrigerators, cisterns, overflows and water tanks, from which water is taken for drinking and cooking purposes, shall in no case be connected with any soil, waste, or drain pipes, but must be discharged into a sink provided for that purpose." (Columbia, S. C., Sewerage and Plumbing Ordinance, Sec. 28)

(*q*) "Overflow Pipes and Motor Exhausts. Pipes from water supply tanks, cisterns, expansion tanks and drip pans, the exhaust from a water lift shall not be directly connected with any house drain, soil, or waste pipe but shall dis-

charge upon the roof, or, be trapped into an open fixture, or discharge as for refrigerator wastes. Under special conditions such pipes may be connected to a rain leader." (St. Louis, Mo., Ord. No. 35748, Sec. 96)

(*r*) "No hot and/or cold water piping or portion thereof, shall be directly connected to any trap, tail piece, drain piping, waste piping, soil piping, house drainage system, sewer, or any portion thereof." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (c), (2))

"No hose, tube or pipe, connected to any hot and/or cold water piping, shall be inserted in, placed in, or connected to, any trap, tail piece, drain piping, waste piping, soil piping, house drainage system, sewer, or any portion thereof." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (c), (3))

(*s*) "Hot Water Heating Systems. The overflow pipe or outlet from hot water heating systems must be carried to the outside of the building so as to discharge freely into the open air, or may be discharged into an open fixture which is properly trapped and vented; said discharge pipe outlet to be at least three (3) inches above the overflow line of said fixture. Under no conditions will the overflow from hot water heating systems be permitted to discharge directly into vent or soil lines." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (n))

(*t*) "(a)

"1. No person shall install or make or cause or permit to be installed or made any cross-connection which is not protected against back-siphonage or any cross-connection which is prohibited by this section.

"2. No person shall maintain, use or permit to be used any cross-connection installed or made after the effective date of this section which is not protected against back-siphonage or which is prohibited by this section.

"3. The phrase "protected against back-siphonage" shall mean protected against back-siphonage by a means or method provided for in Sub-section (b) of this section.

"(b) Every outlet, opening, orifice or termination of any hot or cold water piping (including every faucet, stop cock, valve or similar appliance), through which water is discharged from any such water piping, and every cross-connection shall be protected against the possibility of back-siphonage by means of one of the following means or methods, to wit:

"1. An approved flush valve, together with an approved air inlet or vacuum breaker; or

"2. An approved check valve and vacuum breaker; or

"3. A device approved by the Department for use in lieu of the aforementioned devices.

"(c) No hot or cold water piping, or portion thereof, shall be directly connected to any trap, tail piece, drain piping, waste piping, soil piping, house drainage system, sewer, or any portion thereof.

"(d) No hose, tube or pipe, connected to any hot or cold water piping, shall be inserted in, placed in, or connected to, any trap, tail piece, drain piping, waste piping, soil piping, house drainage system, sewer, or any portion thereof.

"(e) The provisions of this section shall not apply to any water discharging outlet or orifice or opening, provided the lowest portion thereof is elevated a distance equal to the least diameter of such water discharging outlet or orifice or opening, but in no case less than one inch, above the top or rim of any fixed receptacle, fixed tank, fixed equipment or plumbing fixture supplied thereby.

"(f) The provisions of this section shall not apply to any faucet, stop cock, valve, outlet or orifice, provided every water discharging opening therefor is located at least six (6) inches above the floor, paving or surface directly underneath same, and provided such faucet, stop cock, valve, outlet or orifice is not located in any room designed, intended or used for medical, therapeutic, dental, surgical, undertaking, mortuary, autopsy or similar purposes, and provided also that it does not supply water to any fixed tank, fixed receptacle, fixed equipment or plumbing fixture, and provided also, that such installation will not result in a dangerous or insanitary condition in the judgment of the Department.

"(g) The provisions of this section shall not apply to outlets for lawn sprinkler systems which are provided with an approved type of check valve and vacuum breaker installed in a readily accessible place in that portion of the water piping supplying all outlets of each such system and installed at such a location and elevation that there will be no reasonable probability of such device being submerged by surface drainage or by any other cause. The Department may determine the proper location for the installation of each such device." (Los Angeles, Calif., Los Angeles Municipal Code, Ord. No. 80070, Sec. 94.62.2, Back-Siphonage Protection Required)

(*u*) "Water supply connections to swimming pools, hospitals, sterilizers, bed pan sterilizers, house tanks, water cooling devices and plumbing fixtures, shall be made in a manner so as to make impossible the return of any liquid or waste from the swimming pools, sterilizers, house tanks, water cooling devices, or plumbing fixtures, to the water supply system, either by gravity or siphonage, and shall be subject to the approval of the Supervisor of Plumbing." (New Orleans, La., Rules of the Sewerage and Water Board of New Orleans, Plumbing Rules, Sec. 78)

Jacket Water Connections to Sewer

(*v*) "The waste water from a gas engine coil, cooling jacket on pumps or engines, vacuum cleaning filter, laundry machinery or similar apparatus, may discharge indirectly into the house drain by means of a floor drain or sink." (Newark, N. J., Plumbing Code, Sec. 1028, Par. 2, Waste Water From Engine Coils, etc.)

(*w*) "Water supply to cooling jackets must be properly checked and waste from such jackets may be discharged into an open plumbing fixture or into a sewer opening properly trapped and fed with a live plumbing fixture connection to sewer to be separate so that flow of water can be seen and a circulation of air permitted (as amended by Ord. 639)." (Sacramento, Calif., Plumbing Regulations, Sec. 85-A)

Air-Conditioning Connections to Sewer

(*x*) "The following conditions are also deemed to be potentially capable of contaminating the city water supply and are, therefore, hereby prohibited: "Air-conditioning equipment provided with city water supply and direct connection to sewer pipes for waste water. (Waste water must discharge to sewer through a broken connection.)" (Bismarck, N. D., Plumbing Code, Ord. No. 596, Sec. 18-311, I-C-1)

(*y*) "Since the adoption of the present plumbing code in 1937, our plumbing inspectors see that no fixtures are used which will permit back-siphonage. They also see that waste pipes draining condensers, etc. are not connected directly to the sewer pipes, but that an air break is provided." (Syracuse, N. Y., Dept. of Engineering, City Engineer's letter of June 18, 1940)

Manually Operated Sewer Cross-Connections

(*z*) "All frost-proof closets where supply valves waste into soil, waste pipe or sewer." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, F)

(*aa*) "Frost-proof closet bowls shall be flush-rim, oval straight hopper, flushed from a tank. The valve shall be self-draining to a point below frost. Supply shall be protected against water hammer by an approved shock absorber and against siphonage by an open drain waste. The drain waste from the valve shall be led to a dry well containing at least one cubic yard of broken stone or gravel and located not less than ten feet from the wall of any building." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 5, (d) Frost-Proof Closets)

Pump Priming Lines

(*ab*) "Under no circumstances nor conditions will a direct connection be tween the City's water supply and a pump installed and operated for the purpose of pumping any liquid of any character whatever be permitted. The above shall apply to boiler feed water pumps, circulating pumps of all kinds, sewerage pumps, basement bilge pumps, and pumps of all purposes whatsoever, excepting those used for the purpose of re-lifting water from the City's mains into auxiliary supply tanks which supply water for sprinkler systems, circulating ice water systems, hot water heating systems, air-conditioning systems etc., in which case the outlet of the supply line from the pump to the tank must be installed in such a way that the said supply line will go over the top edge of the tank and shall discharge into the tank from the top and the outlet end of the discharge line shall be at least six (6) inches above the elevation of the over-flow of the tank. In all cases and conditions not covered by this ordinance, the City Plumbing Inspector, together with the duly appointed representative of the City Health Department, shall determine whether or not a condition is unsanitary, a source of contamination or a hazard to the public health and safety." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (j) Priming Pumps)

Hydraulic Cellar Drainers

(*ac*) "Hydraulic cellar drainers and sump pumps using an unpolluted water supply shall be protected by placing the supply valve and vacuum breaker a minimum of one foot above the highest level of the basement or cellar floor served by the ejector sump (effective date—immediate)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937, (2))

Discharge From Hydraulic Elevators

(*ad*) "Discharges from hydraulic lifts, hydraulic air compressor, hydraulic motor, sewer ejectors or pumps, that connect to City sewer shall empty into open fixtures so that there will be no possibility of back-flow of sewage into domestic water supply." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (o))

(*ae*) "All water supply equipment and appliances serving special fixtures shall conform with the intent and purposes of this section. Any unusual use for water, as for air-conditioning equipment, hydraulic elevators, presses, fountains, etc., shall be given special consideration in relation to possible pollution of the pure water supply system." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Sec. 56.03, (e))

(*af*) "All water supply equipment and appliances serving special fixtures shall conform with the intent and purpose of these regulations. Any unusual use for water, as for air-conditioning equipment, hydraulic elevators, presses, fountains, aquaria or any other purpose, shall be given special consideration in relation to possible pollution of the public water supply." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 5, (h) Special Fixtures)

(*ag*) "The discharge from Hydraulic Elevators, where the discharge pipe exceeds two inches in diameter, shall be connected directly through the discharge pipe to the main sewer in the street or alley, or be connected indirectly with the house or house sewer through an open tank having a trap, not less than four inches in diameter. This tank must have a sufficient capacity to receive a full discharge of a single operation of the Elevator." (Sacramento, Calif., Health Dept., Plumbing Div., Plumbing Regulations, Ord. No. 496, Sec. 85, Hydraulic Elevators)

Water and Sewer Lines in the Same Trench

(*ah*) "No water service pipe shall be laid in the same trench with a building drain or sewer pipe in the city street. The water pipe shall not be closer to a sewer than eight feet at any point horizontally." (Minneapolis, Minn., Ordinances Pertaining to the Water Works Dept., Sec. 6)

(*ai*) "No water service pipe shall be laid in the same trench with a building drain or sewer pipe, nor shall a water pipe be closer to a sewer than eight feet

at any point horizontally, unless such building drain or sewer pipe be cast-iron soil pipe packed with oakum or hemp and secured with pure lead not less than one inch deep, well calked. This section shall apply only to that part of the service pipe and house drain from the building to the curb." (St. Paul, Minn., Plumbing Code, Sec. 10)

Sewer Lines Over Water Tanks

(*aj*) "All water tanks installed in, near or above buildings for the purpose of furnishing a supply of water which is intended to be used for domestic purposes shall be covered in a thoroughly water-tight manner; said cover to be made of a durable and non-corrosive material. In no case shall such a tank be installed under any pipe carrying sewerage, impure water of any kind of domestic, commercial or industrial waste. In the event such a tank is installed in the basement of a building, it shall be elevated at least one (1) foot above the basement floor and a clear and unobstructed space at least two (2) feet wide must be maintained entirely around the tank. The construction of such tanks shall be accomplished in such a manner as to be proof against the entrance of any kind of vermin or insects whatsoever." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (k) Installation of Water Tanks in Buildings for Domestic Supply)

(*ak*) "Sewers and drains shall never pass directly over water tanks or any place where drinking water, ice, or food is prepared, handled, or stored." (Madison, Wis., Plumbing Ordinance, Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Sec. 56.03, (f))

Sewer-Connected Devices

(*al*) "Cellar drains of the water ejector type." (Bismarck, N. D., Ord. No. 596, Plumbing Code, Sec. 18-311, C-5)

(*am*) "No cellar drains, siphons or any other lift appliance that may cause contamination in the water supply shall be permitted except with special permission of the Plumbing Inspector." (Sacramento, Calif., Plumbing Regulations, as amended by Ord. No. 639, Sec. 88-A)

(*an*) "No plumbing fixture, device or construction shall be installed which will provide a cross-connection between the City supply and a drainage system, soil or waste pipe, so as to permit or make possible the back-flow of sewage or waste into the supply system." (St. Paul, Minn., Water Dept., Rates, Rules and Regulations, Ord. No. 7606, Sec. 10, Plumbing Code, Cross-Connections)

Connections Through Fixtures

(*ao*) "Direct physical connection shall not be allowed between any fixture supplied with city water and any sanitary sewer or storm water drain." (Baltimore, Md., Regulations, Bureau of Water Supply)

(*ap*) "No plumbing fixtures, device, or construction shall be installed which will provide a cross-connection between a distributing system of water for drinking and domestic purposes and drainage system, soil, or waste pipe so as to permit or make possible the back-flow of sewage or waste into the water supply system." (Bismarck, N. D., Plumbing Code, revised, Ord. No. 587, Chap. XVIII, Art. 3, Sec. 18-303 (Ord. 440, No. 101))

(*aq*) "No plumbing fixture or fitting shall be approved for installation which is so constructed that a cross-connection between water supply and waste, or between two separate water supplies, is possible." (District of Columbia, Plumbing Regulation, Sec. 38-A)

(*ar*) "No water pipe, fixture or part thereof shall extend into any receptacle or basin in such a manner so that when water is turned off at stop and waste it will allow any liquid to flow or be drawn into water system." (Kansas City, Mo., Ordinances and Rules of the Water Dept., Rule 28, Direct Water Connections to Sewer Prohibited)

(*as*) "No plumbing fixture, device or construction shall be installed which will provide a cross-connection between a distributing system of water for drinking and domestic purposes and a drainage system, soil, or waste pipe so as to permit or make possible the back-flow of sewage or waste into the water supply system." (Lincoln, Neb., Plumbing Ordinance)

(*at*) "All fixture water supply inlets of every description shall be located and designed so as to prevent the possibility of back-siphonage or back-drainage of any of the fixture contents into the water supply lines." (Madison, Wis., Plumbing Ordinance, Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Sec. 56.03, (d))

(*au*) "Except as hereinafter provided under Regulation 4 (b) 6, no plumbing fixture, pipe connection, or other device or construction shall be installed which will provide an inter-connection (Reg. 1 (f) 2) between a public water supply and a sewer, drainage, soil or waste pipe." New Hampshire, State Board of Health, Rules and Regulations, Reg. 2, (c) Indirect Cross-Connections, or Inter-Connections, Prohibited)

(*av*) "No fixtures having a water connection, either to or from any direct or indirect line of sewer or waste or vent pipe, the construction of which will in any way create a potential cross-connection between the fresh water for drinking or domestic purposes and the sewer, will be permitted." (Pittsburgh, Pa., Fixtures Prohibited, Sec. 59)

(*aw*) "Direct connection of a plumbing fixture to a water supply system is forbidden (except through approved flush valves so arranged as to prevent pollution of the water supply)." Sacramento, Calif., Plumbing Regulations, Connections, Contamination, Sec. 88-A)

(*ax*) "No plumbing fixture, device, or construction, or pipe discharging therefrom or connected therewith, shall be installed or maintained, which

will provide a cross-connection between a water distribution [system,] used for drinking and domestic purposes, and a drainage system. (Spokane, Wash., Ord. No. C-5652, Art. VII, Sec. 79, Supply to Fixtures and Devices)

(*ay*) "No plumbing fixture, device or construction of pipe discharging therefrom or connected therewith, shall be installed or maintained, which will provide a cross-connection between a water distribution [system] used for drinking and domestic purposes and a drainage system." (Tacoma, Wash., Ord. No. 11652, Art. VII, Sec. 28, Water Supply and Distribution, 3)

Toilets With Flush Valves

(*az*) "No water closet of any description shall be supplied with water or flushed directly from the water supply pipes." (Philadelphia, Pa., Dept. of Public Health, Rules and Regulations, Water Closets Not to Be Supplied From Supply Pipes, Rule 72)

(*ba*) "Side inlet bowls are prohibited (effective date—immediate)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937, 4)

(*bb*) "No closet bowl equipped with a flushometer valve shall be installed with a side or rear spud located below the lower part of the flush rim of the bowl." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03 (a))

(*bc*) "All side inlet or back inlet water closet bowls where the water inlet is over three inches below the rim of the bowl." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted (A))

(*bd*) "No closet bowl equipped with a flushometer valve shall be installed with a side or rear spud located below the lower part of the flush rim of the bowl." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 5, Fixtures, (c) Side or Rear Spud)

(*be*) "No water closet or urinal bowl shall be supplied directly from a water supply system through a flushometer or other valve unless such valve is set above the water closet or urinal in a manner such as to prevent any possibility of polluting the water supply." (Bismarck, N. D., Plumbing Code, Revised Ordinance No. 587, Chap. XVIII, Art. 3, Water Supply and Distribution, Sec. 18-303 (Ord. 440, No. 101))

(*bf*) "Integral tank and closet bowl combinations having a discharge from tank below the overflow rim of the bowl, shall have the water supply float valve equipped with an approved vacuum breaker above the high water level of the closet tank in conformity with Paragraph No. 3 (Effective date—Oct. 1, 1937)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects, and General Builders, Apr. 21, 1937)

(*bg*) "No water closet or urinal bowl shall be supplied directly from a water supply system through a flushometer or other valve unless such valve is set above the water closet or urinal in a manner such as to prevent any possibility of polluting the water supply system." (Lincoln, Neb., Plumbing Ordinance, Relief Valves)

(*bh*) "No water closet or urinal bowl shall be supplied directly from a water supply system through a flush valve unless such valve is set above the water closet or urinal in such a manner as to prevent any possibility of polluting the water supply, and the valve is protected as provided herein." (New Hampshire, State Board of Health, Reg. 4, (b), (3. Flush Valve))

(*bi*) "No water closet or urinal bowl shall be supplied directly from a water supply system through a flushometer or other valve unless such valve is set above the water closet or urinal in a manner such as to prevent any possibility of polluting the water supply." (St. Louis, Mo., Ord. No. 35748, Sec. 144, Water Supply to Fixtures)

(*bj*) "No water closet or urinal bowl or any other fixture shall be supplied directly from the city water system through a flushometer or other valve unless such valve is set above the water closet or urinal bowl or other fixture in such a manner as to prevent any possibility of back-siphonage or pollution." (St. Paul, Minn., Rates, Rules and Regulations, Sec. 10, Plumbing Code, Cross-Connections)

(*bk*) "No water closet, urinal, or any other fixture, appliance, appurtenance, or device shall be directly supplied from a water distribution system through a flushometer, or other valve, faucet, bibb, or device; unless such valve, faucet, bibb, or device, and outlet therefrom, is set above the extreme overflow rim of the water closet, urinal, fixture, appliance, appurtenance, or device, in such a manner, or of such construction, as to prevent any possibility of polluting or contaminating the water supply, either by gravity flow, siphonage, back pressure, or by any means whatsoever." (Spokane, Wash., Plumbing and Gas Inspection Div., Ord. No. C-5652, Art. VII, Sec. 79)

(*bl*) "No water closet, urinal or any other fixture, appliance, appurtenance or device, shall be directly supplied from a water distribution system through a flushometer or other valve, faucet, bibb or device, unless such valve, faucet, bibb or device and outlet therefrom is set above the extreme overflow rim of the water closet, urinal, fixture, appliance, appurtenance or device in such a manner or of such construction as to prevent any possibility of polluting or contaminating the water supply, either by gravity flow, siphonage, back pressure or by any means whatsoever." (Tacoma, Wash., Plumbing Code, Ord. No. 11652, Art. VII, Sec. 28, Water Supply and Distribution, 2)

(*bm*) "A potable water supply distributing system shall not be connected to or with any water-closet tank, flush valve, combination or other faucet, or any other plumbing fixture or receptable for waste or surplus water, which is connected directly or indirectly with any sewer, soil or waste of a plumbing system except (1) by discharging over and not less than $\frac{1}{4}$ in. above the level at

which the fixture would overflow on the floor (this means, in the case of lavatories and similar fixtures, ¾ in. if the rim or bead is not over ½ in.) unless the supply pipe thereto be provided with a complete air break of the full area of the supply pipe and located at least 6 in. above the highest water containing part of the fixture." (Wilmington, Del., Rules and Regulations for Plumbing, Div. 6, Water Supply and Distribution, Sec. 63, Water Supply to Fixtures)

(*bn*) "(a) Every flush valve shall either:

"1. Be equipped and provided with a piston plunger or diaphragm which will remain stable and completely closed at all times, when subjected to the vacuum tests provided for in Sec. 94.62.6 of this Article, without the aid of any spring or check in such flush valve, and when equipped with every spring and check to be used in such valve, and also when such flush valve is in its normal operating condition; and any device or arrangement designed, intended or used to maintain, or assist in maintaining, a stable piston shall be subject to the approval of the Department as to its suitability and reliability for such purpose under all conditions of operation and maintenance; or

"2. If such flush valve be equipped or designed otherwise than as outlined above an approved type of air inlet or vacuum breaker shall be installed in the tail piece, said vacuum breaker to be located between the flush valve and the fixture; said air inlet to the vacuum breaker shall have an intake air capacity of not less than the cross-sectional area of the connecting water supply line, said device to be subject to the approval of the Department.

"(b) Every flush valve hereafter installed shall be provided and equipped with an approved type of air inlet or vacuum breaker, which shall have an intake air capacity of not less than the cross-sectional area of the connecting water supply line, and so constructed that the water passage remains closed and the air intake port remains open when the flush valve is idle, said air inlet or vacuum breaker may be either an integral part of the flush valve itself, or it may be a separate device installed in the tail piece between the flush valve and the fixture.

"(c) Every flush valve hereafter installed shall, in addition to the provision of an approved type of air inlet or vacuum breaker, as provided for in Subsection (b), have installed therewith an approved type of check valve in the water line leading to said flush valve." (Los Angeles, Calif., Los Angeles Municipal Code, Ord. No. 80070, Sec. 94.62.4, Flush Valves)

Toilets With Vacuum Breakers

(*bo*) "The following conditions are also deemed to be potentially capable of contaminating the city water supply and are, therefore, hereby prohibited:

"Flushometer-type siphon jet toilets without vacuum breaker. (Vacuum breakers must be placed on all such water pressure-operated toilets.)" (Bismarck, N. D., Plumbing Code, Ord. 596, Sec. 18-311, I-C-6)

(*bp*) "Flush Valves. (1) Every flush valve hereafter installed shall be provided and equipped with an approved type of air inlet or vacuum breaker

which is a permanent and component part of such flush valve, located between the main valve seat and the water outlet of the flush valve, or the tail piece for such flush valve shall be equipped and provided with an approved type of air inlet or vacuum breaker, satisfactory to the Department of Health, except when and as otherwise allowed for a specifically approved type of fixture or receptacle in this ordinance.

"(2) Every such valve shall be installed as required by the provisions of this Ordinance.

"(3) The provisions of this Ordinance, relative to an air inlet or vacuum breaker for a flush valve, shall not apply to any fixture or receptacle to be flushed by a flush valve, provided such fixture or receptacle is equipped and provided with an approved type of air inlet or vacuum breaker which is a permanent and component part of such fixture or receptacle, and provided every such fixture or receptacle, or the type thereof, shall have been approved first by the Department of Health as having an equivalent air inlet or vacuum breaker to that required by this Ordinance for an approved type of flush valve, and provided, further, that in the judgment of said Department, such fixture or receptacle when installed will provide equivalent protection against back-siphonage to that provided by an approved type of flush valve. Every such air intake or vacuum breaker for a fixture or receptacle shall have every portion of the air inlet therefor at least three (3) inches above the top of rim of such fixture or receptacle.

"(4) The provisions of this Ordinance shall not apply to any case where back-siphonage protection is not required by the provisions of this Ordinance, nor in any case where protection against back-siphonage is provided by one of the other methods or means specifically allowed by the provisions of this Ordinance." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (e) 1, 2, 3, 4)

(*bp-1*) "(4) No flush valve, check valve and vacuum breaker, tail piece with vacuum breaker and/or other device required by this Ordinance for protection against back-siphonage shall be installed until the type and/or model thereof has been subjected to and has fully complied with the tests provided therefor in this Ordinance and has been approved by the Department of Health.

"(5) The Board of Health is hereby granted the power and authority to adopt and establish by resolution in writing, test requirements for every check valve and vacuum breaker, tail piece with a vacuum breaker, and/or other device for protection against back-siphonage, subject in each case to the limitations and provisions hereinafter specified in this Ordinance and such test requirements may be modified or revised from time to time when and as deemed necessary by said Board." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (g) 4, 5)

(*bq*) "(e) Back-Siphonage Protection Required. (1) Every outlet, opening, orifice and/or termination of any hot and/or cold water piping (including every faucet, stop cock, ball cock, valve or similar appliance) through which water is discharged from any such water piping, and every cross-connection as defined in this Ordinance, shall be protected against the possibility of back-

siphonage by means of one of the following means and/or methods, to wit: (1) an approved flush valve, together with an approved air inlet or vacuum breaker, complying with, and installed as required by the provisions of this Ordinance; or (2) an approved check valve and vacuum breaker complying with, and installed as required by, the provisions of this Ordinance; or (3) an approved device complying with, and installed as required by the provisions of this Ordinance." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (c) 1)

(*br*) "Any and all physical connections are hereby prohibited between a potable water supply and any non-potable water supply by means of cross-connections, auxiliary intakes, direct connections, by-passes, plumbing appurtenances, fixtures, pumps, water supply wells, discharge wells, pipes, storage tanks or vats, or in any other manner." (Miami, Fla., Div. of Plumbing Inspection, Ord. No. 1191, Sec. 3)

Explanation: "Check valves cannot be considered as an approved safety device. Vacuum breakers must be of an approved type—that is, they must be approved by a recognized testing laboratory of national standing."

Flush Valves With Approved Vacuum Breakers

(*bs*) "All flushometers for closet bowls hereafter installed in any building in the City of Minneapolis shall be protected by approved vacuum breakers." (Minneapolis, Minn., Plumbing Ordinance, Water Pipes, Sec. 17.1)

(*bt*) "All flushometer valves for water closets shall be equipped with a vacuum breaker of a type approved by the Water Board." (New Bedford, Mass., Water Board Regulations, Sec. XV, Supply to Fixtures)

(*bu*) "Flush-valve controlled fixtures, with submerged inlets supplied directly from the City Water Supply System (and not supplied from separate riser and tank) shall be equipped with an approved vacuum breaker in the supply line not less than four inches above the over-flow level of the fixture, to prevent siphonage or back-flow of contaminated water into the house water distribution piping and be checked by the inspector." (New York, N. Y., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, adopted by the Board of Standards and Appeals, Feb. 3, 1939, effective, in accordance with Sec. 665, Sub-Div. C, New York City Charter, Feb. 27, 1939, Rule 1, Flush Valve Fixtures)

(*bv*) "All automatic flush valves for water closet bowls without a vacuum breaker or back-flow check valve for each water closet." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, B)

"All water closet and tanks cast in one piece unless a vacuum breaker or back-water check or back-flow check is installed for each water closet." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, D)

Vacuum Breakers Required With Flush Valves

(*bw*) "Wherever the supply of a fixture is introduced into a fixture below the overflow level, the supply shall be provided with an approved air-break

vacuum device which will prevent the siphoning of water from the fixture into the supply piping and located, together with the supply, at least six inches (6″) above the overflow line of the fixture, so as to prevent drainage by gravity." (Sacramento, Calif., Plumbing Regulations, Ord. No. 496, Fourth Series, Sec. 88-A)

(*bx*) "All plumbing fixtures shall be provided with a sufficient supply of water for flushing to keep them in a sanitary condition. Every water-closet or pedestal urinal shall be flushed by means of an approved tank or flush valve of sufficient flushing capacity and shall be adjusted to prevent the waste of water. The flush pipe for water-closet flush tanks shall be not less than 1½ inches in diameter, and the water from flush tanks shall be used for no other purpose." (St. Louis, Mo., Ord. No. 35748, Sec. 144, Water Supply to Fixtures)

(*by*) "No water closet or urinal bowl shall be supplied directly through a flushometer or other valve unless the valve is set about the water closet or urinal and provided with a vacuum valve to prevent any possibility of polluting the water supply." (Sioux City, Iowa, Plumbing Ord. No. 7235, Chap. 12, Sec. 4, Water Supply to Fixtures)

(*bz*) "A potable water supply distributing system shall not be connected to or with any water-closet tank, flush valve, combination or other faucet, or any other plumbing fixture or receptacle for waste or surplus water, which is connected directly or indirectly with any sewer, soil or waste of a plumbing system except (1) by discharging over and not less than ¼ in. above the level at which the fixture would overflow on the floor (this means, in the case of lavatories and similar fixtures, ¾ in. if the rim or bead is not over ½ in.) unless the supply pipe thereto be provided with a complete air break of the full area of the supply pipe and located at least 6 in. above the highest water containing part of the fixture." (Wilmington, Del., Rules and Regulations for Plumbing and for Gas Installation, July, 1939, Chap. 8, Div. 6, Water Supply and Distribution, Sec. 63)

(*ca*) "(2) Except as otherwise provided in this Ordinance, every check valve and vacuum breaker hereafter installed shall be installed in an approved location and at an elevation which is not less than three (3) inches above the top rim of every tank, receptacle, appliance, apparatus, equipment and/or plumbing fixture; provided, however, that any toilet or urinal flushing tank may have an approved check valve located at any point in the water supply line inside of such tank in case an approved vacuum breaker is so arranged and installed that the air inlet therefor will be at least one-half (½) inch above the top of the overflow pipe for such tank, subject in every case to be approved by the Department of Health.

"(3) Every such check valve and vacuum breaker shall be a combination or unit assembly except when and as otherwise approved by the Department of Health." (El Paso, Tex., An Ordinance Regulating Plumbing . . ., Sec. 26, (f) Check Valves and Vacuum Breakers, 2 and 3)

Bidets and Bed Pan Washers

(*cb*) "Sterilizers, bed pan washers in hospitals, with submergible inlets and direct connections to sewer for waste water." (Bismarck, N.D., Ord. No. 596, Plumbing Code, Sec. 18-311, I-C-11)

"Bidets With Submergible Inlets." (Bismarck, N. D., Ord. No. 596, Plumbing Code, Sec. 18-311, I-C-12)

(*cc*) "Water supply connections to bidets, bed pan washers, or similar apparatus shall be equipped with an approved vacuum breaker and check valve, the latter located between the fixture and the vacuum breaker." (New York, N. Y., Water Dept., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Rule 6, Bidets, Bed Pan Washers)

Ball Cock Inlets

(*cd*) "Ball cock supplies to closet bowls shall be protected either by a vacuum breaker or a physical air break in conformity with Par. No. 3 of this bulletin (effective date—Oct. 1, 1937)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937)

(*ce*) "Flush tanks operated by ball cocks shall have an approved vacuum breaker located not less than one-half inch above the overflow outlet of the flush tank." (New York, N. Y., Water Dept., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Rule 2, Ball Cocks)

(*cf*) "Every tank used for the storage of water for the flushing of a group or battery of toilets and/or urinals shall be a non-pressure tank and shall have the water supply inlet so connected as to keep water from being drawn or forced back into the water supply pipe. The water supply pipe to the tank shall be equipped with both an automatic and manually operated shut-off valve and all such tanks shall have an overflow pipe which shall be carried to a point so as to spill over an open fixture or floor drain. The tank shall be so located and be of a size to give an equal and satisfactory flush to each fixture, as required in Sec. 708. In its meaning, this section does not cover a tank for the flushing of urinals at intervals." (Portland, Ore., Plumbing Code, Ord. No. 72217, Part VII, Sec. 715)

Submerged Inlets to Sewer-Connected Fixtures

(*cg*) "Drinking fountains with submergible faucets." (Bismarck, N. D., Plumbing Code, Ord. No. 596, Sec. 18-311, I-C-10)

(*ch*) "All other fixtures or conditions whereby contamination may enter the city water system." (Bismarck, N. D., Plumbing Code, Ord. No. 596, Sec. 18-311, I-C-13)

(*ci*) "Basins or other waste fixtures supplied with a flexible hose whose outlet may drop into the fixture below the rim of the fixture shall be equipped with a counterbalance or spring reel that will not permit the open end to remain below the rim of the fixture (effective date—Oct. 1, 1937)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders Apr. 21, 1937, (7))

(*cj*) "Drinking fountain shall have an inclined jet with the orifice completely protected with a safety guard, and having the orifice not less than $\frac{1}{4}''$ above the overflow rim (effective date—Oct. 1, 1937)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937, (8))

(*ck*) "In all other cases where the water supply inlet is submerged, a vent opening or air gap must be provided for the purpose of breaking a vacuum to prevent back-siphonage. There shall be a direct relationship between the minimum distance allowed for all such gaps and the inside diameter of the pipe inlet. In no case shall the air gap be less than the distance measured across the inside diameter of the pipe inlet plus $\frac{3}{4}$ of such diameter with an added safety factor of $\frac{1}{2}''$, or the gap may be determined by the formula ($0.5''$ + 1.66 times the inside diameter). The air gap shall be measured from the highest possible level of the water in the flush tank of a flush tank supplied fixture or the rim of a direct supplied fixture or catch basin. FOR EXAMPLE: $1\frac{3}{4}''$ air gap for a $\frac{1}{2}''$ supply pipe and $1\frac{1}{4}''$ air gap for a $\frac{3}{4}''$ supply pipe (effective date—immediate)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937, (3))

(*cl*) "A plumbing fixture shall be supplied with running water through pipes or faucets located one (1) inch above the top of the fixture wherein waste water is deposited." (Newark, N. J., Dept. of Health, Plumbing Code, Sec. 1039, Par. 2)

(*cm*) "Wherever possible the water supply inlet should be raised a sufficient distance above the maximum possible water level of the fixture so as to prevent the possibility of any back-siphonage." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03, (d), (1))

(*cn*) "All fixture water supply inlets of every description shall be so located and designed as to prevent the possibility of back-siphonage or back-drainage of any of the fixture contents into the water supply line." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 4, (b), (4. Inlet))

(*co*) "Wherever possible, the water supply inlet shall be raised the distance stipulated in Reg. 1 (f), above the maximum possible water level of the fixture, so as to prevent any possibility of back-siphonage." (New Hampshire, State

Board of Health, Rules and Regulations Relating to Plumbing, Reg. 4, (b), (5. Over-Rim Inlet))

(*cp*) "Water supply inlets to fixtures shall be located at least one inch above the overflow level of the fixtures except when submerged inlets are absolutely essential for the proper functioning of a fixture." (New York, N. Y., Water Dept., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Rule 3, Submerged Inlets)

(*cq*) "All combination water supply fixtures to lavatories or sinks where the outlet of the water is below the rim of the lavatory or sink." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, C)

(*cr*) "Combination bath tub supply fixtures that extend through bath tub." (Omaha, Neb., Plumbing Ordinance, Plumbing Fixtures Not Permitted, E)

(*cs*) "Sinks in bars, soda fountains, etc., shall be drained to a common open fixture properly trapped and vented, located on the same floor and as near as possible to the bar or fountain in such manner that it may be readily inspected and cleaned. Water supply at all bars, soda fountains, etc., shall discharge at a point at least $\frac{3}{4}$ of an inch above the rim of the fixture." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 25, (n))

(*ct*) "If the water supply inlet cannot be raised above the maximum possible water level, an approved type of vacuum breaker must be installed between the control valve and the fixture in such manner that no back-siphonage is possible under any degree of vacuum in the water lines and with water in the fixture at the maximum possible water level. For positive protection each such fixture must have a vacuum breaker." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03, (d), (2))

(*cu*) "Wherever the supply to a fixture is introduced into the fixture below the overflow level the supply shall be provided with an approved air-break vacuum device which will prevent the siphoning of water from the fixture into the supply piping and located together with the supply, at least 6 inches above the overflow line of the fixture, so as to prevent drainage by gravity." (Wilmington, Del., Rules and Regulations for Plumbing . . . , Chap. 8, Div. 7, Sec. 85, Anti-Siphon Devices)

(*cv*) "If the water supply inlet cannot be raised a sufficient distance above the maximum possible water level, a type of vacuum breaker approved in writing by the Board shall be installed between the control valve and the fixture in such a manner that no back-siphonage is possible under any degree of vacuum in the water line and with water in the fixture at the maximum possible water level. Each such fixture shall have a vacuum-breaker." (New Hampshire State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 4, Water Supply Distribution, (b), (6. Vacuum Breaker))

(*cw*) "Supply to and Connections With Fixtures and Distributing Tanks. The following shall apply to all fixture installations and replacements hereafter made, also to all existing installations in hospitals and other places where infective material is commonly found, in swimming and wading pools installations, in food producing and handling establishments, and in laundries and other places where processing water and/or chemicals are used." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 4, Water Supply Distribution, (b))

(*cx*) "Wherever the supply to a fixture is introduced into such fixture below the overflow level, such supply shall be provided with an approved vacuum breaker which will prevent the siphoning of water from such fixture into the supply piping." (New York, N. Y., Building Code of the City, Par. 14.8.2.8)

Cross-Connections to Fixtures Connected With Special Waste Pipes

(*cy*) "Safe or special waste pipes must not connect directly with any part of the plumbing system. Safe or special waste pipes must discharge over an open, water-supplied, publicly placed, ordinary used sink, placed not more than three and one-half feet above the cellar floor." (Pittsburgh, Pa., Rules, Regulations and Requirements, Safe and Refrigerator Waste-Pipes, Sec. 33)

(*cz*) "Drinking fountains in buildings must be provided with $1\frac{1}{4}''$ trap of either lead or brass or integral with fixture and re-vented with vent not less than size of waste.

"Pedestal drinking fountains set away from building in yard may be provided with $6''$ x $10''$ drum trap not vented. Drinking fountains that have a possibility of cross-connection or back-siphonage between safe water supply and contaminated water shall discharge into an open fixture that is properly trapped and vented. Such drinking fountains supply line to be provided with siphon breaker." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 25, (q))

(*da*) "Drips From Safe Waste. Drips and over-flow from cooling towers, circulating water-cooled jackets, safe waste, or any cooling connection that is cooled with city water, must waste into an open fixture, above the water line of fixture, or may be used as a floor drain trap filler provided the discharge pipe is not introduced into the trap and provided it is not subject to submersion in case floor drain flow is retarded." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 25, (p))

(*db*) "Water supply connections to aspirators, water siphons or similar apparatus shall be equipped with an approved vacuum breaker and check valve, the check valve to be located between the fixture and vacuum breaker. The waste pipes for this type of apparatus shall not connect directly with any drainage system but shall discharge above an open, water supplied, trapped and vented fixture." (New York, N. Y., Water Dept., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Rule 5, Aspirators, Water Siphons)

(*dc*) "Bar wastes, soda fountains, lavatories in barber shops, or dental cuspidors, in old buildings and under unusual conditions, where it is impractical to install a vent pipe, may be connected to soil or waste pipe by using a four-inch deep seal drum trap. *Exceptions:* Drinking fountains. Waste pipes from drinking fountains may be discharged into an open fixture or floor drain without venting." (St. Louis, Mo., Ord. No. 35748, Sec. 97, Bar Wastes, Soda Fountains, etc.)

Protection Against Miscellaneous Water Uses

(*dd*) "The water supply shall be distributed through a system of piping entirely independent of any piping system conveying another water supply, or any piping or device conveying any other thing whatsoever. No connection shall be made, or condition maintained, that would permit the entrance of any unapproved foreign matter into the water distribution system, either by gravity, siphonage, or back-pressure." (Spokane, Wash., Dept. of Public Affairs, Ord. No. C-5652, Art. VII, Sec. 77, Distribution)

(*de*) "Fixture contents against which back-siphonage protection is to be maintained include all pollutional material, sewage, waste water, processing liquids, chemicals, and all water and other liquids which can be polluted at some time or other." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03, (3))

(*df*) "The maximum possible water level referred to above is defined as the maximum possible height to which water can rise in a fixture before it flows out freely into the open atmosphere through adequate size openings so designed as not to be obstructed by debris or waste matter." (Madison, Wis., Protection From Back-Siphonage and Water Supply Pollution From Plumbing Fixtures and Cross-Connections, Plumbing Ordinance, Sec. 56.03, (4))

(*dg*) "No person, firm or corporation who installs, allows to be installed or operates any equipment of any kind, class or description which may contain water unfit for human or domestic consumption shall inter-connect or allow such inter-connection of such equipment to the water supply system of the City of San Diego." (San Diego, Calif., Ord. No. 12742, An Ordinance to Prevent the Contamination and Pollution of the Water Supply of This City, Sec. 2)

(*dh*) "No person shall make a connection or allow one to exist for any purpose whatsoever, between pipes or conduits carrying water supplied by the Department of Water and Power, and any pipes, conduits or fixtures carrying water from any other source or carrying water which has been used for any purposes whatsoever after having left any mains, pipes or conduits under the control of the Department of Water and Power." (Los Angeles, Calif., Ord. No. 77000, Chap. 3, Art. 8, Water Courses and Supply, Sec. 38.02, Water Supply, Contamination)

Addition of Chemicals

(*di*) "Direct water connection to refrigeration unit for cooling purposes shall be equipped with an approved check valve to prevent possible backflow of ammonia or other refrigerant agency from defective condenser coils or jackets, except in such installations where the water supply piping is entirely outside of the piping or tank containing the refrigerant and two independent wall thicknesses of metal separate the refrigerant from the city water supply. Refrigeration units containing more than twenty pounds of refrigerant shall be provided with an additional safeguard in the form of an approved relief valve installed at the outlet side of the check valve, such relief valve being set at five pounds above the maximum water pressure at the point of installation." (New York, N. Y., Rules and Regulations, Water Dept., Rule 9, Condensers, Sub-Div. 4 of Sec. 469)

(*dj*) "Refrigeration and Air-Conditioning. Potable water shall not be used in refrigerating or air-conditioning apparatus, unless the water supply thereto shall be located and provided with a suitable vacuum-breaking or air relief device at least six (6) inches above the top of any chamber or part in which water may be contained, sprayed or circulated." (Springfield, Mass., excerpts from the Building Code, Plumbing, Chap. 16, Sec. 1635.0, (d))

(*dk*) "Be It Further Ordained: That before work is commenced on the construction of any new well or private water supply, or any additions, alterations or changes, including cross-connections, treatment, settling and storage tanks, aerators, wells, suction lines and any other part of such private water supplies as may be listed in any future regulations adopted by the Department of Health, complete plans and specifications, accompanied by such pertinent data as may be required, shall be submitted, by the owner, owners, or his or their agent to the Department of Health, and no part of the work shall be commenced until the Department has given its written approval." (Memphis, Tenn., Ord. No. 6235, Sec. 3)

Ammonia Gas

(*dl*) "Emergency emptying pipes from ammonia tank of any cold storage or refrigerating system, shall not be connected to any house drain or house sewer, or to any part of a plumbing or drainage system." (Newark, N. J., Dept. of Health, Plumbing Code, Sec. 1027, Emptying Pipes From Ammonia Tanks)

(*dm*) "The ammonia shall be discharged into a tank containing sulfuric acid of sufficient quantity to neutralize the ammonia. Such tank shall be securely covered and have a relief pipe not less than three (3) inches in diameter extending to the outer air." (Newark, N. J., Dept. of Health, Plumbing Code, Sec. 1027, Emptying Pipes From Ammonia Tanks)

(*dn*) "Any other system or apparatus intended to neutralize ammonia must be submitted to the Dept. of Health for inspection and investigation and, if accepted, may be used instead of the tank." (Newark, N. J., Dept. of Health, Plumbing Code, Sec. 1027, Emptying Pipes From Ammonia Tanks)

(*do*) "Any line supplying water direct from the City Water Supply System shall be equipped with suitable check valves to guard against back-flow of ammonia to the City Water Supply." (Syracuse, N. Y., Plumbing Code, Sec. XVIII, Art. 10, Pipe Lines Supplying Ammonia Condensors or Compressors)

Storage Tanks

(*dp*) "House supply tanks must be covered so as to exclude dust, and must be so located as to prevent the water from being contaminated by gas and odors from plumbing fixtures." (Philadelphia, Pa., Rules and Regulations, Health Dept., House Supply Tanks, Rule 84)

(*dq*) "Water supply inlets to roof or suction tanks shall be located at least two inches above the overflow level of the tank." (New York, N. Y., Water Dept., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Rule 7, Roof or Suction Tanks)

(*dr*) "It is hereby required that tanks into which water furnished by the Water Department of the City of Tampa is discharged, shall be at such distance below the discharge pipes so that at no time can the water in such tanks raise to a level as to come in contact with the discharge pipe, and that the installation shall be so constructed so that the outlet of the discharge pipes shall be at least six (6) inches above the maximum possible height of the water in the tanks and that the pipes shall be so constructed in conjunction with the discharge of water into the tanks which shall create an atmospheric gap to prevent any possible siphonage or siphoning effect, and it shall be unlawful to construct or erect the said pipes or tanks otherwise than herein prescribed." (Tampa, Fla., Ord. No. 661-A, Sec. 5)

(*ds*) "It shall also be unlawful to maintain storage tanks supplies only with city water, unless the tanks are satisfactorily built and covered so as to prevent the entrance of contamination. They shall also be subject to periodical inspection by the Water Department and be maintained in a manner wholly satisfactory to the standards and requirements of the State Health Department of Texas." (Dallas, Tex., Ord. No. 2133, Sec. 3)

(*dt*) "No person, firm or corporation shall cause a connection to be made or allow one to exist for any purpose whatsoever between the city water supply and any other source of supply, or to cause a connection to be made, or allow one to exist, between the city water supply and any piping system transporting water from any source of supply whatsoever, and which has been subjected to contamination by storage in an insanitary container, such as uncovered and improperly constructed pools, reservoirs, storage tanks and standpipes; and city supply lines discharging into improperly constructed and uncovered pools, reservoirs, storage tanks, standpipes, and insanitary containers of any kind in which the water therein stored is subjected to contamination must discharge into said pools, reservoirs, storage tanks, standpipes, and insanitary containers in such a manner as to prevent siphoning back of the water therein

stored into its city supply line in case of the development of a negative pressure in the city supply lines." (Duluth, Minn., suggested changes to Ord. No. 4185, an Ordinance establishing rules governing the installation of services and meters and the supply of water and gas to customers, Sec. 14, Rule 14-A)

(*dt*-1) "That pools, reservoirs, storage tanks, or any container in which water from the city water system is stored and from which the water therein stored is circulated through pipes connected to the city water supply, must be approved by City Health Department as to their sanitary conditions and ability to adequately protect the water therein stored from contamination before final approval for their use is given by Manager of City of Duluth Water and Light Department." (Duluth, Minn., Ord. No. 4185, Sec. 14, Rule 14-B)

(*du*) "Auxiliary Supply Tanks on Roofs of Buildings or Elevated Tanks or Standpipes. Any supply line from the City's mains or from any booster pump taking water from the City's mains to an auxiliary supply tank for any purpose whatsoever shall be installed in such a way that the said supply line shall go over the top edge of the tank with a 180-degree return bend, the discharge end to terminate at least six (6) inches above the over-flow line or outlet of the tank. Under no circumstances nor conditions shall any supply line to an auxiliary tank discharge through the bottom or side of said tank." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 26, (k), (1))

(*dv*) "No person shall install or allow to exist, any inlet discharging water supplied by the Department of Water and Power in or into any tank, cistern, reservoir or any receptacle for the storage or use of water, unless such inlet shall discharge such water above the maximum possible high water level of such tank, cistern, reservoir or other receptacle for the storage or use of water." (Los Angeles, Calif., Ord. No. 77000, Chap. 3, Art. 8, Water Courses and Supply, Sec. 38.03, Water Supply, Storage, Inlets)

(*dw*) "Where a stand-by water supply has been or is to be installed, pipes carrying water from the potable water supply shall be protected against contact with water from the non-potable water supply by an atmospheric gap of not less than six inches. This may be accomplished through an elevated tank with or without a booster pump or by a cistern with a booster pump. In every case the inlet to the tank or cistern from the line carrying water from the potable supply shall discharge at least six inches above the maximum possible high water level of the tank or cistern." (Miami, Fla., Ord. No. 1191, Sec. 4, (g))

(*dx*) "No licensed plumber or others shall cause a physical connection to be made between the City water supply and any other water supply for commercial, domestic, sanitary, fire protection or boiler feed purposes or for any other purpose whatsoever." (St. Paul, Minn., Rates, Rules and Regulations, Ord. No. 7606, Sec. 10, Plumbing Code, Cross-Connections)

(*dy*) "Except that where dual supplies are necessary or desired, lines carrying the water from the Louisville Water Company's system must be

protected against back-flow of possibly polluted water by an atmospheric gap of not less than six inches. This may be accomplished through an elevated tank with or without a booster pump, or an open cistern with booster pump. In every case the inlet to the tank from the line carrying water from the Louisville Water Company's system shall discharge at least six inches above the maximum possible high water level of the tank or cistern as the case may be." (Louisville, Ky., Rules and Regulations, Water Company, (9) Water Fixtures on the Premises, Foreign Supplies)

(*dz*) "If the City supply is delivered to a tank which is also supplied with water from any source other than the public water supply, such tank shall be open to atmospheric pressure and the public supply shall be supplied above the maximum level of water in the tank and the tank overflow shall be of ample size to fix definitely the maximum level." (St. Paul, Minn., Plumbing Code, Sec. 10, Cross-Connections)

Special Uses

(*ea*) "City water-lubricated and city water-primed pumps of all kinds." (Bismarck, N. D., Plumbing Code, Ord. No. 596, Sec. 18-311, I-C-7)

(*eb*) "Lawn sprinklers shall be protected by the check valve and vacuum breakers (effective date—immediate)." (Detroit, Mich., Dept. of Buildings and Safety Engineering, Bulletin to Plumbers, Plumbing Wholesale Houses, Designers, Manufacturers, Architects and General Builders, Apr. 21, 1937, 5)

(*ec*) "The provisions of this Ordinance shall not apply to each outlet for a lawn sprinkler system, provided an approved type of check valve and vacuum breaker, complying with the provisions of this Ordinance is installed in a readily accessible place in that portion of the water piping supplying all such outlets, and provided such check valve and vacuum breaker is installed in such a location and at such an elevation that there will be no reasonable probability of any such device being submerged by surface drainage or from any other cause, in the judgment of the Department of Health." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 26, (c), (6))

(*ec*-1) "The provisions of this section shall not apply to outlets for lawn sprinkler systems which are provided with an approved type of check valve and vacuum breaker installed in a readily accessible place in that portion of the water piping supplying all outlets of each such system and installed at such a location and elevation that there will be no reasonable probability of such device being submerged by surface drainage or by any other cause. The Department may determine the proper location for the installation of each such device." (Los Angeles, Calif., Ord. No. 80070, Los Angeles Municipal Code, Sec. 94.62.2 (g))

(*ed*) "Water Supply for Circulating Systems. The water supply for all mechanically or electrically operated systems in which water is circulated for the purpose of supplying or extracting heat, such as air-conditioning systems, cooling towers, heating systems in which water is circulated by means of

pumps or other similar equipment, and all systems where, in the judgment or opinion of the City Health Department, water may be subject to contaminating influences, shall be supplied with water taken from a tank which is in no way connected directly to the City's water mains. Said tank must be supplied by a pipe from the City's mains controlled by a manually operated valve, said pipe to be installed over the top edge of the tank with a 180-degree return bend, the outlet to be at least six (6) inches above the elevation of the overflow line or outlet of said tank." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 26, (m))

(*ee*) "All premises intended for human habitation or occupancy shall be provided with a supply of potable water which shall not be connected in any manner with a non-potable water supply nor cross-connected through plumbing fixtures or otherwise to the drainage system, *nor connected to an appliance*, tank, or other object using, conveying, storing or holding any substance except potable water." (Miami, Fla., Div. of Plumbing Inspection, Dept. of Public Service, Ord. No. 1191, Sec. 2)

(*ef*) "Any and all physical connections are hereby prohibited between a potable water supply and any non-potable water supply by means of cross-connections, auxiliary intakes, direct connections, bypasses, plumbing appurtenances, fixtures, pumps, water supply wells, discharge wells, pipes, storage tanks or vats, or in any other manner." (Miami, Fla., Div. of Plumbing Inspection, Dept. of Public Service, Ord. No. 1191, Sec. 3)

(*eg*) "Water supplies to plumbing fixtures and to fixtures or appliances serving a special purpose shall deliver water above the spill line of fixtures or be protected by an approved vacuum breaker." (Minneapolis, Minn., Plumbing Ordinance, Water Pipes, Sub-Sec. 17.1)

(*eh*) "Water supply connections for priming purposes to sump, well or similar type pumps shall be connected to the inlet side of the pump and be equipped with an approved vacuum breaker and check valve, the check valve to be located between the pump and the vacuum breaker." (New York, N. Y., Rules Relative to Submerged Inlets and Protective Methods to Be Applied to Prevent Contamination of Water Supply, Water Dept., Rule 8, Sump or Well Pumps)

(*ei*) "Fixture.* Any appliance connected directly or indirectly to or arranged as an outlet for any water supply, or any appliance arranged as an inlet to a sewer or to a drainage, soil or waste disposal system.

"* Fixture includes the following and other possible items: water closets, bath tubs, sitz tubs, catch basins, slop sinks, floor or shower drains, kitchen or pantry sinks, urinals, wash-trays, wash basins, lavatories, drinking fountains, dental cuspidors, swimming pools, baptistries, ornamental fountains, hydrants, air-conditioning equipment, hydraulic elevators, hydraulic presses, aquaria, laundry and bottle-washing machines, processing machines used in industry and all water-connected hospital equipment such as sterilizers, bed pan washers, hydraulic aspirators, etc." (New Hampshire, State Board of Health, Rules and Regulations Relating to Plumbing, Reg. 1, (g))

(*ej*) "Baptistries, ornamental and lily pools, aquaria, ornamental fountain basins and similar constructions shall have the supplies thereto protected from siphonage or gravity drainage cross-connections by means of suitable air-break devices placed on the supply above the overflow level of the fixture." (Syracuse, N. Y., Plumbing Code, Art. 12, Swimming Pools and Their Equipment and Installation, Sec. XVIII)

(*ek*) "Metropolitan District water will not be supplied to premises where the pipes used to convey or distribute the same are so connected directly or indirectly with any supplementary or secondary fire or other water service system, as to receive a possible water supply from any source other than that furnished by the District System.

"Piping systems supplying swimming pools or other tanks in which water may become polluted, shall be so arranged as to preclude water from re-entering the distribution system and shall in each case be approved by the Manager and Chief Engineer of the Water Bureau." (New York, N. Y., Cross-Connections Prohibited, Sec. 45 and 46)

(*el*) "Water supply connections to swimming pools, hospital sterilizers, toilets, urinals, bidets, or any other plumbing fixture or appliance shall be made in a manner so as to make impossible the return of any of the liquid or waste from the swimming pool, sterilizer, toilet, urinal, bidet, or any other plumbing fixture or appliance to the water supply of any distributing system either by gravity, siphonage, back-flow, or any other method that could contaminate the water supply of any distributing system, and all water piping and connections shall be inspected by the Inspector of Plumbing." (Providence, R. I., An Ordinance in Amendment of Chap. 43 of the Revised Ordinances of 1914, entitled "Plumbing and Drainage," Chap. 987, Sec. 27)

Dual Supplies

(*em*) "Every city water service connection to establishments using a secondary water supply for any purpose whatsoever, or which employ stand-by intakes or other supplies for emergency uses, shall be protected by a special arrangement of valves and checks as hereinafter provided. Secondary supplies and emergency sources shall include: Surface waters from rivers, lakes, ponds, lagoons and reservoirs; well waters both deep and shallow; any supply of water which has been stored, held or reserved after being used for industrial purposes, cooling water, or which has in any way been treated, processed or has been subjected or exposed to any contamination of a bacteriological or chemical nature; and water from any source other than the city supply." (Detroit, Mich. Dept. of Health, Bureau of Sanitary Engineering; Regulations for the Protection of City Water Lines in Instances Where Auxiliary Supplies Are Employed for Any Purpose Whatsoever, adopted by the Board of Health, July 23, 1917, amended Mar. 10, 1925, amended Feb. 11, 1936, Sec. 1)

(*en*) "No cross-connections shall be permitted between the City water supply and any private source of supply except where it is safeguarded by one of the following methods:

"1. Complete disconnection between the supplies

"2. Remove a section of pipe on the City or well feeder which can be replaced in event of emergency

"3. Double valves with a bleeder or drain between them, valves to be sealed or locked together, and cap made available for bleeder in event of emergency

"4. Double check valves (as amended by Ord. 639)."

(Sacramento, Calif., Plumbing Regulations, Health Dept., Plumbing Div., Ord. No. 496, Cross-Connections, Sec. 88-C)

(*eo*) "Removal of direct cross-connections of the city water lines and any supplies other than the city water may be done as follows: At a point where the city water line enters the building a section of pipe shall be removed and valves attached at either end of the cut. The valve on the city water line shall be sealed and said seal shall not be broken until the city health officer or water department is notified. Connection to the City water line shall be made only after the private supply is disconnected from the building water lines and the city health officer or water department notified. This connection shall be made with a nipple or straight pipe with unions on either end. The connection shall be made so that city water is the only supply furnishing the building water line." (Bismarck, N. D., Plumbing Code, Ord. No. 596, Sec. 18-311, I-E)

(*ep*) "In every instance where dual supplies exist, all exposed piping carrying city water shall be uniformly painted a distinguishing bright blue color and so maintained that each pipe may be readily traced in its entirety by such color. In instances where the bright blue color conflicts with already well established systems of painting in a particular plant, the Sanitary Engineer of the Department of Health may allow the use of another color of equal brightness and distinction. Detailed plans of all underground or unexposed piping both for city supply and secondary supply, shall be furnished to the Department of Health, and corrections made thereto as soon as alterations are made." (Detroit, Mich., Dept. of Health, Bureau of Sanitary Engineering; Regulations for the Protection of City Water Lines in Instances Where Auxiliary Supplies Are Employed for Any Purpose Whatsoever, adopted by the Board of Health, July 23, 1917, amended Mar. 10, 1925, amended Feb. 11, 1936, Sec. 6)

(*eq*) "The maintenance of a pressure system of water supply whose purity is questionable, such as cistern water, in the same building in which a pure water supply exists is to be discouraged, especially if the water is piped throughout the building and not confined to a certain section for special uses or processing. The piping containing such impure water supply shall be painted red and properly labeled at intervals. Under no circumstances must the two supplies be cross-connected or provision made for their cross-connection except as provided for in industrial buildings in the regulations of the Wisconsin Water Works and Sewerage Code."

"*Note:* Proper design of piping system is an important factor in the prevention of vacuum formation in pipe and possible resultant pollution of the water supply. See data on pipe sizing elsewhere in this code." (Madison, Wis., Plumbing Ordinance, Sec. 56.03 (g))

(*er*) "No service connection will be allowed from the city mains to any premises supplied by water from any other source unless special permission is given by the Superintendent, which special permission may be terminated at any time, if in the judgment of the Superintendent, the public interest would be best served." (Seattle, Wash., Water Rates, Ord. No. 65877, Sec. 5)

(*es*) "In the case of the establishments herein mentioned, where a cross-connection is involved, the water supply therein for drinking and ablutionary use shall not be taken from the system thus connected but shall be derived from a separate line to be laid on from the street side of the check-valve system." (New Hampshire State Board of Health, Regulations Relating to Cross-Connections, Reg. 5, Drinking Water Supply)

(*et*) "No water service pipe or supply pipe connected with the public main shall be cross-connected in any manner to or with any pipe supplied with water from a well, cistern, river, or any other source than the public main." (District of Columbia, Plumbing Regulations, Sec. 38-A)

(*eu*) "No pipe of the city's water works system shall be connected to or put in communication with any pipe, pump, well or other device in which is confined or conveyed water from any source of supply other than the city's water works system." (Duluth, Minn., Ordinances and Regulations, Ord. No. 4185, Connections to Other Supplies, Sec. 14, Rule 14-a)

(*ev*) "The water supply for the plumbing system shall be distributed through a piping system entirely independent of any piping system conveying another water supply." (St. Louis, Mo., Ord. No. 35748, Sec. 138, Water Supply Distribution)

(*ew*) "The city water shall not be supplied to any premises where the pipes used to convey or distribute the city water are so connected, either directly or indirectly, as to receive a possible water supply from any source other than that furnished by the Municipal Water Works." (Springfield, Mass., Rules and Regulations, Foreign Supplies, Rule 15)

(*ex*) "The domestic and drinking water supply shall be distributed through a piping system entirely independent of any piping system conveying another water supply." (Syracuse, N. Y., Plumbing Code, Sec. 18, Water Supply and Distribution Pertaining to Sanitary System, Art. I, Distribution)

(*ey*) "If any person, firm or corporation, as the owner of the property, shall have upon said property a supply of water other than the supply of water furnished by the Water Department of the City of Tampa, and also have upon said property a water supply furnished by the Water Department of the City of Tampa, such owner shall have and is hereby required to have a dual system of pipes upon the property, one system of pipes being for water supplied by the Water Department of the City of Tampa, and the other system of pipes being for the supply of water from the private supply." (Tampa, Fla., Water Dept., Cross-Connections, Ord. No. 661-A, Sec. 4)

(*ez*) "Whenever the water supply of the Light, Gas and Water Division or a quasi-public water supply is used for drinking and a non-potable water supply is used for fire protection, industrial or other purposes, such non-potable water supply shall be distributed through an independent piping system having no cross-connection with the water supply of the Light, Gas and Water Division, or other quasi-public water supply, and shall not be rendered available for drinking or other personal or domestic uses." (Memphis, Tenn., Ord. No. 6235, Sec. 8, (b))

(*fa*) "Provision for a removable nipple in a new installation will be considered a physical connection, and does not meet the requirements contained herein." (St. Paul, Minn., Plumbing Code, Sec. 10, Cross-Connections)

(*fb*) "The installation or insertion of a removable nipple in a line which connects the City water supply with any other source of supply shall be done only with written permission of the Board of Water Commissioners and then only in case of emergency, and the nipple shall not be left in place longer than the period of the emergency." (St. Paul, Minn., Plumbing Code, Sec. 10, Cross-Connections)

(*fc*) "Combination faucets having another supply (such as hot water) in addition to the city water supply." (Bismarck, N. D., Ord. No. 596, Sec. 18-311, I-C-8)

Pumps and Pressure-Producing Devices on Water Lines

(*fd*) "No pipe of the city's water works system shall be connected to or put in communication with any pipe, pump, well or other device in which is confined or conveyed water from any source of supply other than the city's water works system." (Duluth, Minn., Ordinances and Regulations Governing the Water and Light Department, Ord. No. 397, Sec. 14, Connections to Other Supplies, Rule 14-a)

(*fe*) "Consumers will not be permitted to install pumps pumping water directly from the service pipes, but must have an intervening vessel into which to receive the water, and from which it may be pumped." (Louisville, Ky., Rules and Regulations, Water Company, Sec. 20, Boilers and Pumps)

(*ff*) "All pumps and hydrants shall be protected from surface water, contamination and possible cross-connection. Connections must be so arranged that polluted water cannot enter pipe between valve and nozzle. Drips must not be connected to the sewer." (Wilmington, Del., Rules and Regulations for Plumbing, Chap. 8, Div. 6, Sec. 70, Pumps and Hydrants)

Water Lines to Hydraulic Elevators

(*fg*) "Pipes from water supply tanks, cisterns, expansion tanks and drip pans, the exhaust from a water lift shall not be directly connected with any house drain, soil, or waste pipe but shall discharge upon the roof, or, be trapped into an open fixture, or discharge as for refrigerator wastes. Under special conditions such pipes may be connected to a drain leader." (St. Louis, Mo., Ord. No. 35748, Sec. 96, Overflow Pipes and Motor Exhausts)

(*fh*) "Except as hereinafter provided the use of city water is hereby prohibited for the operation of hydraulic elevators by direct pressure." (Springfield, Mass., Rules and Regulations, Hydraulic Elevators, Rule 13, 1)

Vacuum Systems

(*fi*) "Drinking water systems, vacuum cleaning systems, yard sprinkler systems and fire standpipe lines are to be installed by licensed and registered plumbers." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 26, (p))

Aspirators

(*fj*) "Aspirators on surgical, dental or industrial equipment operated by water ejectors. (City pressure must not be used. Pressure may be obtained by discharging city water through a broken connection to a receiving tank from which water may be drawn by means of a small pump and furnished to the fixture or ejector.)" (Bismarck, N. D., Ord. No. 596, Sec. 18-311, I-C-2)

(*fk*) "Municipal Code of Chicago" (Chap. 82, Plumbing Provisions, and Chap. 83, Water Supply and Distribution System)

(*fl*) "Sterilizers used in hospital laboratories and for surgical and medical purposes, shall discharge into an open sink and the outlet end of the drain pipe shall be trapped." (Newark, N. J., Plumbing Code, Dept. of Health, Sec. 1030, Par. 2, Sterilizers)

(*fm*) "Water supply connections to Swimming Pools, Hospital Sterilizers, Bed Pan Sterilizers, House Tanks, Water Cooling Devices and Plumbing Fixtures, shall be made in a manner so as to make impossible the return of any liquid or waste from the Swimming Pools, Sterilizers, House Tanks, Water Cooling Devices, or Plumbing Fixtures, to the Water Supply System, either by gravity or siphonage, and shall be subject to the approval of the Supervisor of Plumbing." (New Orleans, La., Rules of the Sewerage and Water Board, Sec. 78)

(*fn*) "Direct water supply piping connections to sterilizers are prohibited. The waste piping for sterilizers shall not connect directly with any drainage system, such waste piping shall discharge above an open, water-supplied, trapped and vented fixture." (New York, N. Y., Rules and Regulations, Water Dept., Rule 4, Sterilizers)

(*fo*) "All hospitals and doctors' offices, and other places where the need therefor has been determined by the Plumbing Inspector, shall be equipped with sterilizers to be approved by the Plumbing Inspector. The sterilizers shall be so constructed and installed as to effectively prevent cross-connections or back-siphonage." (Oklahoma City, Okla., City Health Dept., Ord. No. 5135, Sec. 43, Sterilizers)

(*fp*) "Consumers using city water in boilers, heating plants and the like must provide broken connections of drain and waste lines therefrom to the sewer. Hot water heaters and hot water storage tanks must have a check valve on the supply line and a suitable relief valve on the discharge side." (Bismarck, N. D., Plumbing Ordinance, Ord. No. 596, Sec. 18-311, I-D)

(*fq*) "Automatic devices for filling tanks, boilers and vats through a submerged inlet with overflow connections to sewer. (Such inlets must discharge *above* the overflow line at least six inches.)" (Bismarck, N. D., Plumbing Ordinance, Ord. No. 596, Sec. 18-311, I-C-3)

(*fr*) "Devices for heating water and storing it in "boilers" or hot water tanks, shall be so designed and installed as to prevent all danger from explosion and also prevent a back-flow of hot water through a meter connected with a public water supply." (Sioux City, Iowa, Plumbing, Ord. No. 7235, Chap. 5)

Boiler Connections

(*fs*) "Pumps for feeding boilers or for any other purpose must not be directly connected with the water mains or supply pipes." (Albany, N. Y., Bureau of Water, Rules and Regulations (17))

(*ft*) "Steam boilers shall not take a supply of water directly from the service-pipe and depend upon the hydraulic or hydrostatic pressure in the water pipes to supply them under working pressure. Boiler feed pumps, injectors, inspirators, etc., shall not be connected directly with the service-pipe, as such methods are faulty and dangerous, but shall have an intervening vessel into which to receive the water, and from which to supply the boilers." (Louisville, Ky., Rules and Regulations, Water Company, Sec. 20, Boilers and Pumps)

(*fu*) "No stationary steam boiler shall be connected directly with the water distribution system of said city, but in each and every case, a suitable tank, of storage capacity sufficient for a twelve-hour supply for said boiler, shall be provided, and the service pipe supplying said tank shall discharge directly into the top of said tank." (Santa Barbara, Calif., Ord. No. 1564, Drawing Water Into Steam Boilers, Sec. 22)

Fire Services

(*fv*) "No physical connection will be permitted between the city water supply and any industrial, fire, or other auxiliary or emergency water supply, whether potable or non-potable. This prohibition applies to all piping systems either inside or outside of any building or buildings." (Baltimore, Md., Dept. of Public Works, Bureau of Water Supply, Bureau Regulations)

(*fw*) "The fire protection service lines must be a separate system and shall not have a physical connection with either a Water Department service line for domestic or commercial consumption or with an independent source of supply. Water from the City supply shall discharge into any cisterns or tanks connected with an independent source of water supply above the overflow level of said cisterns or tanks." (Little Rock, Ark., Municipal Water Works, Water Dept., Rules and Regulations)

(*fx*) "Where water from another source is desired for additional fire protection it may only be used as hereafter provided:

"(1) An elevated tank supplied by a connection from the city mains at a point above the overflow in the tank. The tank may then be connected to the sprinkler system or other piping in the plant.

"(2) Construct a concrete reservoir to which the City mains are connected and provide pumps to pump water from this reservoir to the elevated tank or standpipe."

(Oklahoma City, Okla., City Water Dept., Ord. No. 4747, Sec. 1, Rules and Regulations)

(*fy*) "Any fire protection system supplied with water from the city service shall be supplied exclusively with such water, and no connection will be allowed with any other system drawing its supply from any other source whereby the city water supply may be subjected to contamination by failure to close valves, or leaking check valves, etc., and no auxiliary or secondary suction pipe to any underwriter's pump taking water from any private source will be permitted." (St. Paul, Minn., Rates, Rules and Regulations, Water Dept., Cross-Connections, Sec. 7)

(*fz*) "No licensed plumber or others shall cause a physical connection to be made between the City water supply and any other water supply for commercial, domestic, sanitary, fire protection or boiler feed purposes or for any other purpose whatsoever." (St. Paul, Minn., Ord. No. 7606, Plumbing Code, Sec. 10, Cross-Connections)

(*ga*) "No connection shall be made at any time between the fire service pipe system and the regular water supply to the premises. Valves on hose outlets, drain cocks, etc., placed on the pipe system, shall be of a style that can be sealed by the Water Department." (St. Paul, Minn., Water Dept., Rates, Rules and Regulations, Sec. 7, Fire Supplies, Cross-Connections to Domestic Service)

Right to Make Inspections

(*gb*) "Be It Further Ordained: That whenever a cross-connection between the Light, Gas and Water Division water supply and a private water supply has been made, the premises shall at all times be open for inspection by any agent or representative of the Light, Gas and Water Division, and of the Superintendent or of any officer or representative of the Department of Health, and, if on inspection it is found that the city water supply might become contaminated through such cross-connection because of some potential danger of contamination to the other water supply, then the Light, Gas and Water Division shall have the right to discontinue the city water service upon such premises upon written recommendation by the Superintendent of the Department of Health, that such discontinuance should be effected." (Memphis, Tenn., Ord. No. 6235, Sec. 10)

(*gc*) "Employees of the Bureau of Water Works shall have free access, at proper hours of the day, to all parts of buildings and premises for the purpose of inspecting the condition of the pipes and fixtures and the manner in which the water is being used." (Portland, Ore., Rules and Regulations for the

Supply and Use of Water, Ord. No. 70338, Art. III, Sec. 17, Access to Premises for Inspection)

(*gd*) "The Superintendent of the Water Department of the City of Tampa and any of the deputies or inspectors of the Water Department of the City of Tampa shall have and are hereby given authority and right to go and enter at all reasonable times on private property where water is supplied by the Water Department of the City of Tampa for the purpose of making inspection of water pipes and to do any and all acts or things to carry into effect the provisions of this Ordinance." (Tampa, Fla., Ord. No. 661-A)

Right to Shut Off Water

(*ge*) "All existing cross-connections are hereby declared to be in violation of the ordinance described herein and their removal forthwith is hereby ordered. Removal of cross-connections is hereby declared to be under the jurisdiction of the city health officer and in a manner satisfactory to said officer." (Bismarck, N. D., Ord. No. 596, Plumbing Ordinance, Sec. 18-311, I-F)

(*gf*) "If deemed necessary, the Department of Health shall declare an emergency and order the City Water Department to discontinue its water service immediately and, before water service can be renewed the City Water Department shall notify the Department of Health of intention to re-connect the same, and it shall be the duty of the Department of Health to enter said property and inspect the same, and if it finds the same in a proper, safe, and sanitary condition, it shall issue to the said Water Department a certificate or notice that the plumbing is in a safe and sanitary condition and, until said certificate or notice is issued, it shall be the duty of the said Water Department to refrain re-connecting the same." (El Paso, Tex., An Ordinance Regulating Plumbing . . . , Sec. 26, (3))

(*gg*) "Be It Further Ordained: That the Superintendent of Water Works of the City Council of Augusta shall have the right to discontinue the City water service upon premises where cross-connections exist, upon written recommendation of Richmond County Board of Health that such discontinuance should be effected." (Augusta, Ga., Plumbing, Ord. No. 1117, Sec. 5)

"Be It Further Ordained: That, it is the intent of this ordinance that whenever the City water supply is involved, and in the opinion of the Superintendent of Water Works of the City Council of Augusta any cross-connection endangers the City supply, then and in that event the Superintendent shall have the right to sever the cross-connection by shutting off the City water supply." (Augusta, Ga., Plumbing, Ord. No. 1117, Sec. 8)

(*gh*) "Should any connection be found to exist on any premises between the city's water works system and water from any other source, the department shall notify the owner or agent to disconnect the same, and should it not be promptly disconnected, the water supply shall forthwith be shut off until

compliance with the notification shall have been accomplished." (Duluth, Minn., Ord. No. 4185, Sec. 14, Rule 14-B)

(*gi*) "All permits for water supply service shall be subject to cancellation, at the option of the Water Department, and service thereunder may be discontinued for any of the following acts or violations of rules:

"(a) For adding to premises any fixtures or connections and not having same made by a licensed plumber, and failing to make proper reports to the Water Department office.

"(d) Where plumbing fixtures are installed which are not satisfactory to the Water Department and not in accordance with the rules thereof." (Kansas City, Mo., Water Dept., Ordinances and Rules, Sec. 1055)

(*gj*) "Whenever any physical connection, direct or indirect, is found to exist or to be liable to exist between any private water system and the Louisville Water Company's system, the Louisville Water Company's supply will be shut off from the premises forthwith." (Louisville, Ky., Water Company, Rules and Regulations, Sec. 9, Foreign Supplies)

(*gk*) "Be It Further Ordained: That it is the intent of this ordinance that whenever the water supply of the Light, Gas and Water Division is involved, and in the opinion of the Light, Gas and Water Division the existing cross-connection endangers or potentially endangers the city supply, then and in that event, the Light, Gas and Water Division shall have the right to sever the cross-connection by shutting off the water supply of the Light, Gas and Water Division." (Memphis, Tenn., Ord. No. 6235, Sec. 14)

(*gl*) "In addition to the foregoing penalty, City water service shall be discontinued upon any premises upon which there is found to be connection between the City water supply and another source of water supply, and such service shall not be restored until such cross-connection has been discontinued. The provisions of this section shall in no manner limit or interfere with the enforcement of the penalties for such violation as elsewhere provided in this ordinance, but shall be cumulative and in addition to such penalties." (Oklahoma City, Okla., Rules and Regulations, City Water Dept., Ord. No. 4747, Sec. 4)

(*gm*) "In addition to the foregoing penalty City water service shall be discontinued upon any premises upon which there is found to be any connection unlawful under this ordinance between the City water supply or the City water supply system and another source of water supply or another water supply system, and such service shall not be restored until such cross-connection has been discontinued." (Santa Barbara, Calif., City Ord. No. 1671, Sec. 1)

(*gn*) "No service connection will be allowed from the city mains to any premises supplied by water from any other source unless special permission is given by the Superintendent, which special permission may be terminated at any time, if in the judgment of the Superintendent, the public interest would be best served.

"In no case shall any cross-connection be allowed between two or more city service connections, or between any city service connection and pipes

supplying water from any other source." (Seattle Wash., Ord. No. 65877, Sec. 5)

"It shall be unlawful for any person to make connections with any fixtures or connect any pipe with any water main or water pipe belonging to the Municipal Water Supply System, without first obtaining permission so to do from the Superintendent." (Seattle, Wash., Ord. No. 65877, Sec. 46)

(*go*) "The Board of Water Commissioners reserves the right at all times to shut off the water temporarily without notice (although it is intended to give such notice when possible) for necessary repairs, extensions, alterations, or other necessary work connected with the distribution system; and also for non-payment of bills or for neglect or refusal to comply with the rules and regulations of the Board." (Springfield, Mass., Rules and Regulations, Water Dept., General, Rule 9)

"The water supply is liable to be shut off in cases of neglect or failure to observe or comply with the conditions and regulations required or which may be required by the Board." (Springfield, Mass., Rules and Regulations, Water Dept., Rule 13, (6))

"Whenever any possible physical connection, direct or indirect, is found to exist or to be liable to exist between any private water system and the city water system, the city water supply will be shut off from the premises." (Springfield, Mass., Rules and Regulations, Water Dept., Rule 15)

(*gp*) ". . . it shall be unlawful for the two systems to be connected together in any manner whatsoever, provided, however, that all supplies of water upon property in the City of Tampa now being operated in violation of the provisions of this Section of this Ordinance shall be given thirty (30) days notice in writing to disconnect the water and private supply and to make the dual system of pipes as required herein for the City and private supply, and if the changes as herein provided for and required are not made within the period of time specified in the notice, the water supply of the City of Tampa shall be discontinued and shall not be restored until the provisions of this Section of the Ordinance are complied with and the fee paid as provided in Sec. 2 of this Ordinance." (Tampa, Fla., Water Dept., Ord. No. 661-A, Sec. 4)

Control of Service at Time of Issuance

(*gq*) "No water service or connection will be granted to serve premises supplied with water from any other source than the mains of the Board, provided, however, that if the owner of the premises so supplied from a source other than the mains of the Board shall enter into an agreement, binding on himself and the successive owner or owners of the premises to be supplied, whereby such owner agrees not to make or permit any cross-connection between the water supply system of the Board and any other supply or system for or upon such property, and shall either pay the scheduled rate for such premises without deduction for any benefit derived from any outside source of supply, or install a meter for such premises under the rules and regulations

of the Board and pay for water at the scheduled meter rates, a service or connection shall be granted to such premises under the rules and regulations of the Board." (City and County of Denver, Colo., Board of Water Commissioners, Rules and Regulations, Sec. 6)

"*Whereas*, it is contrary to the rules of the party of the first part that any water service or connection be made from its mains to serve property supplied with water from any other source than the mains of the party of the first part unless an agreement substantially in the form of the within agreement be entered into by and between the party of the first part hereto and the owner of the property so to be supplied with water from the mains of the party of the first part.

"1. That the party of the second part, . . . heirs, successors and assigns, will not cross-connect the water supply from the above mentioned surface well or any other source to any pipe, faucet or other device whereby water from such well or any other source might in any manner whatsoever be introduced into the mains of the party of the first part, its successors or assigns, and will not allow any such cross-connection in or upon the above described premises contrary to the rules of the party of the first part, its successors and assigns." (Agreement between the City and County of Denver, Colo.)

(*gr*) "That any person, firm or corporation whose premises are supplied with water from the city water supply system, and who also have on the same premises a separate source of water supply or stored water in insanitary pools, storage tanks, standpipes, or any other insanitary container from which the water therein stored is circulated through a piping system shall file with Manager of City of Duluth Water and Light Department, a statement of the non-existence of cross-connections." (Duluth, Minn., Water and Light Dept., Ord. No. 4185, Sec. 14, Rule 14-C)

(*gs*) "(c) That any person, firm or corporation whose premises are supplied with water from the Light, Gas and Water Division, and who shall also have on the same premises a separate source of water supply that is non-potable, but is circulated through a piping system, shall file with the Light, Gas and Water Division a statement of the non-existence of cross-connections.

"*Sec. 9.* Be It Further Ordained: That hereafter it shall be unlawful for any person, firm or corporation to cause a connection to be made or allow a connection to exist for any purpose whatever between the distribution system of the Light, Gas and Water Division, and any private water supply, unless the quality of such private water supply, and the inter-connection of the two supplies, shall be approved, in writing, by the Department of Health." (Memphis, Tenn., Ord. No. 6235, Sec. 8, (c) and Sec. 9)

(*gt*) "Consumer's Declaration of Non-Existence of Cross-Connections.

"Pursuant to the provisions of Ordinance No. 900 of the City of Nashville, and rules and regulations affecting the service of water by the Nashville Waterworks Department, (we, I) do hereby declare that no cross-connection exists between the City water supply and any other source of supply as prohibited by the provisions of Ordinance No. 900 of the City of Nashville upon premises at ——— and that (we are, I am) the (owner, occupant) of said premises.

"(We, I) further acknowledge receipt of copy of Ordinance No. 900 relating to cross-connections, and do hereby agree not to permit any such cross-connection upon said premises.

"(We, I) further certify that there is no private water supply or any water stored or any provision by which water may be retained in storage, and that there is no cesspool or equipment for the pumping of sewage upon said premises except as follows:" (Nashville, Tenn., Nashville Water Works Dept.)

(*gu*) "Any person, firm or corporation having any other source of water supply upon his or its premises, either previous to the passage of this ordinance or installing same hereafter, is hereby required to make a "Customer's Declaration of Non-Existence of Cross-Connections," upon the form supplied by the Water Department in the form and manner prescribed by the Superintendent of the said Water Department before he or it shall be entitled to obtain or continue the use of the City water supply." (Oklahoma City, Okla., Ord. No. 4747, Sec. 1)

"Consumer's Declaration of Non-Existence of Cross-Connections.

"To the Water Superintendent,

"Oklahoma City Water Department.

"Pursuant to the provisions of Ordinance No. 4747, amending Section 36 of Chapter 20 of the Revised Ordinances of Oklahoma City, Oklahoma, of 1928, and rules and regulations affecting the service of water by the Oklahoma City Water Department, (we, I) do hereby declare that no cross-connection exists between the City water supply and any other source of supply upon premises at ——— and that (we are, I am) the (owner, occupant) of said premises.

"(We, I) further acknowledge receipt of copy of said Ordinance No. 4747 relating to cross-connections, and do hereby agree not to permit any such cross-connection upon said premises.

"(We, I) further certify that there is no private water supply or any water stored or any provision by which water may be retained in storage, and that there is no cesspool or equipment for the pumping of sewage upon said premises except as follows:" (Oklahoma City, Okla., Water Dept.)

(*gv*) "Upon request of the Department, consumer must sign an affidavit to the effect that no cross-connection exists on the premises served, or state the size and location of the same if any do exist." (San Francisco, Calif., Water Dept., Rules and Regulations, Rule 12e, Cross-Connections)

(*gw*) "It shall be unlawful for any person to make connections with any fixtures or connect any pipe with any water main or water pipe belonging to the Municipal Water Supply System, without first obtaining permission so to do from the Superintendent." (Seattle, Wash., Water Rates, Ord. No. 65877, Sec. 46)

Legal Aspects of Cross-Connection, Inter-Connection and Back-Flow Protection

By Robert E. Moore, Jr.

I. Introduction

A. Purpose of the Study

IN EVERY struggle for, and at the beginning of every program designed to effect, the abatement of any public health evil or danger, the question arises, "How can I, as Health Officer, as Building and Safety Inspector, or as a Water Department Official, best proceed to achieve the desired results?"

In his paper, Goudey has suggested: (1) an appreciation and comprehension of the problem involved; (2) an improved technical knowledge of the several phases of that problem; (3) the co-operative efforts of interested administrative bodies and officers; (4) an educational program designed to acquaint subordinate employees and the public generally with the dangers of cross-connections, inter-connections and back-flow, and with the advantages to be derived from their control or elimination; and (5) in the event that the program of "appeasement" fails, the obtaining of, and resort to, enforcement (administrative or penal) of comprehensive statutory and administrative provisions.

It is obvious from a consideration of the subject matter of the paper that the ailments of the administration of an effective sanitary control of potable water supplies are: (1) avarice, (2) ignorance, and (3) laissez-faire.

The fault of "avarice" is confined primarily to those short-sighted individuals or corporations who believe that the present saving of a

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few dollars is worth the gamble with the health or lives of themselves, their associates, and of the public generally. This trait is usually exhibited when the health authorities attempt to regulate or eliminate conditions which have existed on a particular premises from a time antedating the passage of the act providing for their control or elimination.

The fault of "ignorance" is, in many instances, excusable, particularly with respect to individual members of the general public. As yet there have been no widespread educational programs designed to acquaint such individuals with the hazardous and dangerous potentialities of cross-connections and inter-connection and back-flow conditions; and, due to lack of funds and personnel, administrative bodies in the various political subdivisions throughout the country have not been able to formulate and enforce a general campaign for such an educational program. On the other hand, it is unfortunately all too true that the officials and boards of these same political subdivisions have been lax in availing themselves of data that would acquaint them with the scope of the problems connected with scientific methods of eliminating the aforementioned conditions.

The fault of "laissez-faire" is as dangerous a fault as that of studied ignorance, for it reflects itself in the same result, namely, a failure to protect properly the health, safety and welfare of the inhabitants of such political subdivisions. This fault is best illustrated by the type of health officer or water department superintendent who, in reply to questions concerning *his* cross-connection elimination program, states, "we have had no difficulty with this problem and our survey shows that no such danger exists." In nearly every such instance, the particular city or utility, with which such officer is connected, has no law or rule and regulation designed to control or eliminate cross-connections, inter-connections or back-flow, and no real effort is made by such city or utility to undertake a full survey of the situation; and, if and when such conditions do exist, the health administrators have no real ability to recognize and/or remedy them. It is easier for such an administrator to say that *no situation has been found* than to take active steps to discover it and to effect its elimination.

Until the increasingly important educational program, now under way throughout the country, has achieved more definite and lasting results, it will continue to be necessary for public officers to "crack down," now and then, upon those individuals and corporations who

deliberately, or through ignorance or neglect, resist or defy law enforcement efforts of such officers.

It is with the fifth phase, suggested by Goudey's paper, the failure of "appeasement" methods, in mind that this study of the problem was made; and it is hoped that the reader will find herein some answers to his many questions regarding the legal problems of health and sanitary control. Some of these questions which undoubtedly should be answered and which the writer has attempted to answer are:

1. What is the duty of municipalities and their water companies with respect to the service and supply of safe and potable water and their liabilities for a breach of such duty?

2. What have legislative and administrative bodies done by way of statutory enactment and rules and regulations to control the procurement and maintenance of such a water supply?

3. How have the courts interpreted, and aided in the enforcement of, these legislative acts and these administrative rules and regulations?

4. What *new* provisions, and what more modernized versions of already existing provisions, of the sanitary laws with respect to the regulation and control of cross-connections and related evils, which might prove beneficial in meeting the specific problems of a particular city, county, district, or state, should be adopted therein and thereby?

B. Scope of the Legal Phase

The problem of the sanitary control of public water supplies is such a great one that it would be impossible, in a study of any reasonable length, to cover the whole field. The immensity of the problem has been suggested in the previous section of this paper; and, to answer some of the questions there suggested, this paper will hereinafter discuss the following subjects and furnish, at least in part, the following data:

1. Legal theories and public policy re: protection of public health.

2. Liabilities, both statutory and at common law, of municipalities and of water companies generally.

3. Decided cases with respect to the promulgation and administration of health laws, rules and regulations.

4. Illustrative statutory provisions re: public health.

5. Water department rules, regulations and service requirements.

6. A proposed form of ordinance re: cross-connection, inter-connection and back-flow elimination.

II. Legal Theories and Public Policy Re: Protection of Public Health

A. Public Health as the Primary Concern of the Sovereign

Throughout the ages the healing of the sick has been the prerogative and the chief concern of doctors of medicine; but, as we all know, the modern trend of medical practice is toward "preventive medicine."

In the early history of the administration of public health and sanitation, the problem of the sanitarian and of the health officer seems to have been, primarily, the abatement of an epidemic already begun, the elimination of pollution already an active source of disease, and the formulation of a few general rules and regulations designed to penalize or restrict those persons who had already contributed to the ill-being of the community. The removal and abatement of unhealthful and harmful conditions of filth and disease, however, is not, and should not be, the only concern of such officers.

The state and its several subdivisions, acting by, and through, its public health administration personnel, have a higher duty and obligation than that just expressed. It may truly be said that the prevention and elimination of, and the discovery and use of successful methods of protection against, cross-connections, inter-connections and back-flow are today among the most effective and desirable modern "preventive medicines" in the field of water supply and sanitation.

The lives, health and safety of the inhabitants of a municipality (even of a large "home rule" city) are not matters of a purely municipal concern which can be localized and delimited by city boundaries, but the concern of the whole state. Where a function, such as this, is partly a state and partly a local concern, the city is free to act until the state has intervened, but the power of such city is subordinate to that of said state and must be asserted in such a way that the two can work together in harmony.[1]

The protection and preservation of public health are among the prime governmental concerns and functions of the state as a sovereignty; and the state, acting through its general assembly, may enact general laws to that end.[2]

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[1] Adler *v.* Deegan, (N. Y.) 167 N. E. 705, at 707–709.

[2] State *v.* Underwood, 22 N. E. (2d) 424 at 426 (Ohio).

B. Theoretical Bases for Exercise of Police Power

The police power of the state embraces every law which concerns the welfare of the whole or any part of the people of the state and operates upon the persons and things within it,[3] whether it relates to their rights or duties, whether it respects them as men or citizens of the state, whether it affects them in their public or private relations, and whether it relates to the rights of persons or property of the whole people of the state or of any individual within it.

The police power is not susceptible of circumstantial precision. It extends not only to regulations which promote the public health, morals, and safety, but to those which promote the public convenience or the general prosperity; it is the most essential of powers, at times the most insistent, and always one of the least limitable of the powers of government.[4]

In a general way the police power extends to all the great public needs; it may be put forth in aid of what is sanctioned by usage, or held by the prevailing morality or strong and predominant opinion, to be greatly and immediately necessary to the public welfare.[5] It may properly be exercised for preserving the public health, safety, morals, or general welfare, and its regulations may reasonably limit the enjoyment of personal liberty, including the right of making contracts.[6]

The limits of the power of the state to enact laws to protect the health, safety, morals and general welfare of its people must always be determined with appropriate regard to the particular subject of its exercise.[7] Health being the *sine qua non* of all personal enjoyment, it is not only the right but the duty of a state or a municipality possessing the police power to pass such laws or ordinances as may be necessary for the preservation of the health of the people.[8]

The police power is the exercise of a sovereign right of a government to promote order, safety, health, morals and the general welfare of a city within constitutional limits.[9] It is an inherent attribute of sovereignty and is an essential element of all orderly governments, being founded on the duty of the state to protect its citizens and

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[3] New York *v.* Miln, 11 Pet. 102.
[4] Sligh *v.* Kirkwood, 237 U. S. 52; 35 Sup. Ct. Rep. 501; 59 L. Ed. 835.
[5] Noble State Bank *v.* Haskell, 219 U. S. 104; 55 L. Ed. 112.
[6] Coppage *v.* Kansas, 236 U. S. 1; 59 L. Ed. 441.
[7] Near *v.* Minnesota ex rel Olson, 283 U. S. 697; 75 L. Ed. 1357.
[8] 12 C. J. Const. Law. 913, §425.
[9] 16 C. J. S. Const. Law 537, §174.

provide for the safety and good order of society; and, in its nature, it is broad and comprehensive.[10]

The police power is very broad and far reaching and it is difficult, if not impossible, to fix its bounds definitely. Indeed it is inadvisable to attempt to frame any specific definition of the police power, which would, and could, absolutely indicate its limits, by including everything to which it might extend and by excluding everything to which it could not extend. The courts consider it wiser to decide these limits as each case arises, as the power is co-extensive with the necessities of the case and the safeguards of the public interest.

The reasonableness of a police regulation is not necessarily what is best, but what is fairly appropriate under attendant circumstances; and the possession and enjoyment of all rights are subject to a reasonable exercise thereof, and everything contrary to public policy or inimical to public interest is subject to its exercise.[11]

The police power is one of the attributes of state sovereignty and cannot be limited by contract. It operates upon property and property rights, including contract, to the extent necessary for the protection of the public health, safety, morals and welfare.[12] In its exercise the use of property may be restricted or may be destroyed and no legal liability arises to compensate the owner therefor. Therefore the burden is upon the person claiming indemnity under provisions of a regulatory statute to prove clearly that his property, so destroyed, was such as contemplated by said statute.[13]

The police power conferred upon California municipalities by the constitution of that state is as broad as that possessed by the legislature itself, subject to the two exceptions that its exercise by any city must be confined to the municipality and must not conflict with the general laws of the state. The exercise of this power is *not* limited to the regulation of such things as already have become nuisances or have been declared such by a judgment of a court. A city's power to prohibit or regulate under the police power not only includes nuisances, but extends to everything expedient for the preservation of the safety, health or comfort of the city's inhabitants.[14]

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[10] 16 C. J. S. Const. Law 539 to 540, §175.

[11] 16 C. J. S. Const. Law 541 to 543, § 175; 11 Am. Jur. 1020-1024, §271, Constitutional Law.

[12] Sutter Butte Canal Co. *v.* Railroad Commission, 202 Cal. 179 at 184; DeBerry *v.* City of La Grange, 8 S. E. (2d) (Ga.) 146 at 149.

[13] Lertora *v.* Riley, 6 Cal. (2d) 171 at 178.

[14] Boyd *v.* City of Sierra Madre, 41 Cal. App. 520 at 523.

The police power is not a circumscribed prerogative, but is elastic and, in keeping with the growth of knowledge and the belief in the popular mind of the need for its application, capable of expansion to meet existing conditions of modern life and thereby to keep pace with the social, economic, moral and intellectual evolution of the human race. In brief, there is nothing known to the law that keeps more in step with human progress than does the exercise of this power.

In providing for the common welfare, the statutes of California take into consideration "open space for light, ventilation, health, comfort, and convenience"; even sentiment has had an influence in extending the limitations of the exercise of police powers. Police power in its most comprehensive sense embraces the whole system of internal regulation, and extends to the protection of all persons within its jurisdiction, and to their health, comfort and quiet.[15]

The limitations of the police power are plastic in their nature. They will expand to meet the actual requirements of an advancing civilization and will adjust themselves to the necessity of the multiplying complexities in moral, sanitary, economic and social conditions.[16] In some states the police power extends even beyond the corporate limits for a short distance in order that a municipality may more properly protect the territory within its boundaries.[17]

Ordinances adopted pursuant to the police power need not expressly state that they are so enacted, nor, as a general rule, need they state or explain the reasons for the enactment nor declare specifically that the subject matter regulated therein is a nuisance.[18]

The police power extends to each object of government, but not beyond that. It does not extend to arbitrary, capricious or unreasonable action ostensibly taken to promote the public safety, health, morals, general welfare or prosperity, but having no reasonable relation to any of those objects.[19]

The distinction between the "police power" and the power of "eminent domain" is stated to be this:

"Police power controls the use of property by the owner, for the public good, its use otherwise being harmful; while 'eminent domain'

[15] Thille *v.* Board of Public Works, 82 Cal. App. 187 at 190.

[16] Herrin *v.* Arnold, 82 Pac. (2d) (Okla.) 977 at 979; Royce *v.* Rosasco, 287 N. Y. Supp. 692 at 703; Tighe *v.* Osborne, 131 Atl. 801 at 803 (Md.).

[17] City of Homewood *v.* Wofford Oil Co., 169 So. 288 at 289 (Ala.).

[18] Bellerive Inv. Co. *v.* Kansas City, 13 S. W. (2d) (Mo.) 628 at 634–5.

[19] Clifton Hills Realty Co. *v.* City of Cinn., 21 N. E. (2d) (Ohio) 993 at 997.

and taxation take property for public use. Under eminent domain, compensation is given for property taken, injured or destroyed, while under the police power, no payment is made for a diminution in use, even though it amounts to an actual taking or destruction of property."[20]

1. Public Policy re: Health

It has become increasingly true throughout the several states that "public policy" dictates that stringent laws and administrative rules and regulations be promulgated, which will effect the elimination and/or the control of all types of property and personal activity contributing to, or causing, hazardous and unhealthful conditions, including the pollution and the rendering unpotable of the domestic water supply.

a. Public Policy Generally: "Public policy" is the legal principle that no citizen can lawfully do that which has a tendency to be injurious to the public or which is against public good. The legislature's utterance on a particular subject within the limits of its constitutional powers is the "public policy" of the state and such policy is to be determined by statutes or court decisions and not by the private conviction or notions of a particular judge.[21]

The purity of a state's potable water supply is the pre-eminent factor in the valid exercise by a water policy commission of powers conferred upon it by state statute; and such statute is to be liberally construed to advance its beneficent policy.[22]

The preservation of public health is a duty devolving upon the state as a sovereign power; and discharge of such duty is accomplished by means of the exercise of the inherent police power of such sovereign.[23] The fundamental purpose of government is to protect the health, safety and general welfare of the public and the state has power to impose restrictions on the ownership of property for the promotion thereof.[24]

It is, and should be, the policy of the courts to further and to aid the efforts of public corporations to improve and to add to any and

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[20] Appeal of White, 134 Atl. (Pa.) 409 at 411.

[21] State *v.* Gateway Mortuaries, (Mont.) 287 Pac. 156 at 157.

[22] Jersey City *v.* State Water Policy Commission, (N. J.) 191 Atl. 456 at 458-9.

[23] Erlanger *v.* Regents of the University of the State of New York, 10 N. Y. Supp. (2d) 1013 at 1019.

[24] Hafner *v.* Erdreich Realty Corp. 11 N. Y. Supp. (2d) 142 at 144.

all facilities looking to the health, comfort and social advance of the public; and to this end immaterial technicalities are not, and should not, be considered.[25]

b. Duty of State: It is one of the first duties of a state to take all steps necessary for the promotion and protection of the health and comfort of its inhabitants; and it is within the police power of such state to take such action as may reasonably tend toward that end.[26] It has been said that the state exists to promote the welfare of its citizens including their peace, happiness and prosperity; and to this end the legislative department of the state is primarily charged with the duty of determining by what means this purpose can be accomplished and, for its accomplishment, is invested with all legislative power except as restricted by the state or federal constitution.[27]

In connection with the aforementioned duties of the state with reference to public health and welfare, it has been held that the common law is not static, but is constantly undergoing changes and extensions to meet the changing conditions brought about by the ever-expanding business and social fabric.[28]

c. Duty of County: It has been held, under statutes similar to the Health and Safety Code of the State of California (hereinafter cited), that the county board of health, within its jurisdiction, is the statutory tribunal upon which is imposed the duty of protecting the general health of the people of the county, and that it is under the further duty of seeing that sanitary conditions are maintained and that the police powers to abate nuisances created by unsanitary conditions should be liberally construed to accomplish their purpose.[29]

d. Duty of Municipality: One of the primary functions of a municipality is to protect the safety, convenience, comfort and common welfare of its citizens by establishing and maintaining those things which tend to promote, and by regulating, or prohibiting, those things which are included within the scope of this function for, the protection of public health and the abatement of public nuisances.[30]

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[25] Bannister *v.* Lollis, (So. Car.) 190 S. E. 511 at 512.

[26] Patrick *v.* Riley, 209 Cal. 350 at 354; 25 Am. Jur. Health, §3, p. 287.

[27] Albritton *v.* City of Winona, (Miss.) 178 So. 799 at 803.

[28] Woodmen of the World Life Insurance Society *v.* Guyton, (Ala.) 194 So. 655 at 658, 659.

[29] Jefferson County *v.* Jefferson County Fiscal Court, (Ky.) 108 S. W. (2d) 181–3.

[30] Nourse *v.* City of Russellville, (Ky.) 78 S. W. 761 at 763–4.

It is not only the right but the duty of a city to maintain the purity of its water supply for the domestic use of its inhabitants.[31] Municipalities have the inherent power and authority to provide for the general welfare and health of their citizens; and this power and authority are to be liberally construed.[32] They may not only exercise the police power of the state to preserve the public health, but the law enjoins a duty upon them to abate promptly or to remove all nuisances by which the public health may be affected.[33]

e. Duty of Privately Owned Public Utility: Where the public water supply is supplied by a privately owned public utility (including a water company) there is a duty on the part of the municipality to see that a potable and safe water supply is furnished and to void the franchise or contract, or both, if such requirement is not complied with.[34]

There is also a corresponding duty on the part of the utility to provide a safe and adequate water supply or other commodity.[35]

2. Dedication to Program of Public Health

A review of the authorities above cited should enable all water works engineers, superintendents and sanitarians to obtain a better and fuller picture of the duties and obligations devolving upon their respective states and the several political subdivisions and departments thereof, and should lead them to dedicate themselves to a program designed to effect: (1) all desirable changes in, and additions to, existing health and sanitation codes; (2) a more comprehensive interpretation of those laws by the proper administrative officials; and (3) a more effective and widespread co-operation on the part of the general public by permitting and inviting an elimination or control of the evils referred to above.

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[31] Phillips *v.* City of Golden, (Colo.) 14 Pac. (2d) 1013 at 1014.

[32] Letz Manufacturing Co. *v.* The Public Service Commission of Indiana, (Ind.) 4 N. E. (2d) 194 at 198.

[33] Spear *v.* Ward (Ala.) 74 So. 27 at 30; 25 Am. Jur. 288, §4; People *v.* Ryan, 243 N. Y. Supp. 644 at 649-650; Duncan *v.* City of Des Moines, (Iowa) 268 N. W. 547, 548.

[34] Montana Water Company *v.* City of Billings, (Mont.) 214 Fed. (D. C.) 121 at 125; Mann *v.* Des Moines Water Co., 202 Fed. (C. C. A. 8th) 862 at 865.

[35] City of Burlington *v.* Burlington Water Company, (Iowa) 53 N. W. 246 at 249; Missoula Public Service Co. *v.* The Bitter Root Irrigation Dist., (Mont.) 257 Pac. 1038 at 1040; Arkansas Power & Light Co. *v.* Cates, (Ark.) 24 S. W. (2d) 846 at 850.

III. Statutory and Common Law Liabilities of Municipalities and Water Companies Generally

The existence of insanitary conditions in connection with the public water supply continually jeopardizes the life, health and well being of the general public. This fact becomes apparent from the repeated occurrence of sickness which can be traced to no other source. There have been many cases of nausea and diarrhea, stomach trouble and even sporadic cases of typhoid and dysentery which have indicated probable contamination of the local water supply. In addition, such epidemics as that which occurred in 1933, in the Congress and Auditorium Hotels in Chicago, are so outstanding as to make health and water department officials realize that actual danger exists.

The moral and legal liability of a municipality and of its water department to its consumers should be, and is, an incentive to carry on an aggressive campaign to minimize the danger of contamination of, and in, the drinking water supply and system. The fact that dangerous insanitary connections exist between drinking water systems and sources of pollution or contamination places a grave responsibility on those departments of municipal government that are charged with the health and well being of the general public. In addition to the moral responsibility of good citizenship, there is the legal responsibility of such departments and their officials. This responsibility may be reflected not only in actions for damages against those departments and officials but also in the imposition of penal sanctions for criminal negligence.

The City of Chicago and the Congress and Auditorium Hotels are still in litigation over more than $6,000,000 in damage suits resulting from the dysentery epidemic of 1933; and in a case involving Pittsburg, Calif., judgments totaling $33,000 have been awarded to persons who brought suit for damages against the city following the typhoid epidemic of 1920.

A. Statutory Liability

1. General Health Laws

To illustrate the types of liability which are ordinarily imposed upon water companies by statute, the writer has used certain of the California General Laws and Code provisions and one of the pertinent rules and regulations of the California State Board of Health. It will be found that the provisions, so cited and quoted, are similar to

those in effect in those states which have followed California's example in this regard.

It is provided in the California "Pure Water Law"[36] that:

"It shall be unlawful for any person, firm, corporation, public utility, municipality or other public body or institution to furnish or supply or to continue to furnish or supply water used or intended to be used for human consumption or for domestic uses or purposes which is impure, unwholesome, unpotable, polluted, or dangerous to health, to any person in any county, city and county, municipal corporation, village, district, community, hotel, temporary or permanent resort, institution or industrial camp."

After providing that the water distributing agency must obtain a permit to operate, and the State Department of Health must make inspections to determine whether or not such a permit should be granted, the Act further provides that:

"Any person, firm, corporation, public utility, municipality or other public body or institution who shall furnish or supply or continue to furnish or supply water used or intended to be used for human consumption or for domestic uses or purposes, or shall install, additions to, modifications or alterations in, any of the existing plant[s], works, system[s], or sources of supply without having an unrevoked permit from the state board of health so to do, as in this act provided, may be enjoined from so doing by any court of competent jurisdiction, at the suit of any person or persons, firm, corporation, municipal or other public corporation whose supply of water for human consumption or for domestic uses or purposes is taken, or received from, or supplied or furnished by any such water furnishing or distributing person, firm, corporation, public utility or municipality or other public body or institution, or it or he may be enjoined at the suit of the state board of health in the same manner."

The violation of said act is declared to be a "nuisance" and it is stated that:

"Anything done, maintained or suffered in violation of any of the provisions of this act shall be deemed to be a public nuisance dangerous to health and may be summarily abated in the manner provided by law and it shall be the duty of all and every public officer or officers, body or bodies lawfully empowered so to do to immediately abate the same."

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[36] Deering's General Laws, Act 9111, §§1-2, as amended, pp. 4267-69-70.

A penalty for the violation of said act is imposed upon the public utility as follows:

"Every person, firm, corporation, public utility, municipality or other public body or institution, or officer, employee or agent thereof upon whom the duty to act is cast, and every person who shall violate any provision or part thereof of this act, or who shall fail to obey, observe or comply with any direction, order, requirement or demand or any part or provision thereof of the state board of health, or who procures, aids or abets any such person, firm, corporation, public utility, municipality, or other public body or institution, or officer or employee or agent thereof, in any failure to obey or comply with the provisions of this act or the orders of the state board of health as provided in this act, shall become liable for and forfeit to the state of California the penal sum of not more than one thousand dollars for each separate offense. The continued existence of any violation of this act for each and every day beyond the time stipulated for compliance with any of its provisions or of any order of the state board of health as provided herein shall constitute a separate and distinct offense. All penalties are to be recovered by the state in civil action brought by the state of California and such penalties when collected shall be paid into the general fund of the state treasury."

The officers of the public utility also are liable for any violation of the act, including the delivery of an unpotable or polluted water supply. The act provides that:

"Every officer, agent or employee of any person, firm, corporation, public utility, municipality, or other public body or institution or person who shall violate or fail to comply with any of the provisions of this act or the order of the state board of health or any part thereof, or who procures, aids or abets in any failure to observe and comply with any such provision, order, or part thereof, is guilty of a misdemeanor and is punishable by a fine not exceeding one thousand dollars or by imprisonment in the county jail not exceeding one year or by both such fine or imprisonment, for each offense. Each day's violation of this provision shall constitute a separate and distinct offense."

The California State Department of Health has promulgated a regulation covering dual water supplies and cross-connections,[37] which reads, in part, as follows:

[37] Rules and Regulations, California State Board of Health, November, 1919, amended May 12, 1924.

"(2) There shall be no physical connection between such a private source of supply or system and a public water system without a permit therefor, granted by the State Board of Health.

"Dual water supplies and sources with which cross-connection exists, or is desired in any form to any public water supply system, shall be held as subject to all the provisions of the Sanitary Water Systems Act. All persons, firms, corporations, public utilities, municipalities or other public body or institution supplying water for domestic consumption, shall make separate application for permit, under the provisions of the Sanitary Water Systems Act, to supply water from each and every such dual source of water supply or sources with which there exists or it is desired to make any cross-connection. Failure to obtain permit so to do, or aiding or abetting in the making or use of said dual supplies or any cross-connection to a public system without obtaining said permit, shall be adjudged as a violation of the provisions of the Sanitary Water Systems Act and subject to all of the penalties provided in said Act.

"(3) Water companies or municipalities now or in future furnishing water for domestic purposes, regardless of whether an unrevoked domestic water supply permit from the State Board of Health is held, shall be held responsible to its consumers for pollution of the public system by violation of section (2) and shall forbid service to premises maintaining cross-connections which may pollute the public system, or shall prevent the pollution of the public system by other means acceptable to the State Board of Health. Violations shall constitute sufficient grounds for revoking any domestic water supply permit."

2. Criminal Liability of Public Utilities and Their Officers and Employees

In California anyone who unlawfully neglects or refuses to perform any duty under the health laws of the state is guilty of a misdemeanor.[38] This liability extends to every person who violates, or refuses or neglects to conform to: ". . . any sanitary rule, order, or regulation prescribed by the State Department of Public Health for the prevention of the pollution of springs, streams, rivers, lakes, wells, or other waters used or intended to be used for human or animal consumption. . . ."[39]

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[38] California Penal Code, §378.

[39] California Health and Safety Code, §4457, p. 103.

The California Health and Safety Code provides for the regulation of plumbing; and certain powers and duties, with respect to the issuance of a license and to the inspection and supervision of plumbing installations purportedly effected in conformity with the terms of said license, are imposed thereby upon the state health officer. With regard to the obligations of a plumber, it is provided that: "It is unlawful for any person to carry on business, or labor as a master or journeyman plumber, in any city unless he has obtained from the board of health of the city a license authorizing him to carry on that business, or to labor as such mechanic."[40] And, as to any failure by the health officer with respect to his duties, the code provides that: "every person who violates any provision of this chapter is guilty of a misdemeanor."[41]

B. Common Law Liability

That a water utility is liable in damages for injury or death caused by, or the direct or indirect result of, the pollution of the domestic water supply is now fairly well established in all jurisdictions throughout the United States. This is especially true where the utility has allowed pollution of any sort to enter its supply mains. Where pollution has taken place on the premises of a consumer by virtue of conditions existing on the service side of the water meter, the question of such liability is not so clear. In that connection, it has been held that the water company is not "an insurer" and that it is only required to exercise reasonable care to ascertain the existence of, and to eliminate, dangerous and unhealthful conditions on such premises. It is also clear, however, that, if the water distributing agency knows, or has reason to know, that a dangerous and hazardous condition does exist, it is then legally responsible for any injury or death which may occur by reason of its failure, within a reasonable time, to remedy such situation and by its continuance of a supply of water under such conditions.

1. Liability Arising out of the Supply and Distribution of Polluted and/or Contaminated Water

While a water company is not an insurer or a guarantor of the purity of its water or of its freedom from infection, it is bound to use reasonable care in ascertaining whether there is a reasonable prob-

[40] Health and Safety Code, §800, p. 22.
[41] Health and Safety Code, §811, p. 24.

ability that its water supply may be infected with a communicable disease from causes which are known to exist, or which could have been known or foreseen by the exercise of such care. For a failure to use such care the company will be liable in damages to persons injured by reason of the impurity; and if the exercise of such care would have disclosed a reasonable probability of such infection, then it becomes the duty of a water company to adopt whatever approved precautionary measures are, under the circumstances, reasonably proper and necessary to protect the community which it serves from the risk of infection. It is no part of the duty of the consumer to investigate the water supply and to ascertain possible sources of pollution. Complaints made to the health officers of the polluted condition of the water have been held to be at least some notice to the city of the existence of such condition.[42]

a. Cases Involving Illness From Typhoid Fever: The following cases give a cross-section of the type of litigation which has arisen in connection with purported typhoid fever illness or death, allegedly resulting from polluted water. Unless some unusual feature is present, only a brief statement will be made with regard to each case.

(*1*) *Dickie* v. *City of Centralia;* 157 Pac. (Wash.) 1084: This was an action for damages for illness purportedly due to polluted water. No facts appear, due to the successful interposition, by the city, in a demurrer, of the defense of a failure to file a claim.

(*2*) *Sheer* v. *City of Everett;* 235 Pac. (Wash.) 789: Here, again, the city was successful in evading the question of liability for damages due to illness, by reason of the failure of the plaintiff to file a claim. It was held that the fact that for a time the plaintiff did not know the cause of the illness did not excuse such failure.

(*3*) *Roscoe* v. *City of Everett;* 239 Pac. (Wash.) 831: In this case polluted water was permitted to pass into the city mains through a by-pass connection at the plant of a milling company. The "gate valve" was worked by hand and when closed effectually prevented water from passing through the pipe. It was held that the city was liable in damages for the death of plaintiff's decedent by reason of polluted water passing through the bypass. The promise of the milling company to prevent pollution was held not to excuse the city.

[42] 67 C. J. Waters, §842, p. 1282.

(*4*) *Aronson* v. *City of Everett;* 239 Pac. (Wash.) 1011: Here minors, acting through their legal representative, recovered $6,000 for the death of their mother, caused by water pollution. The source of the pollution was the same as that referred to in the *Roscoe* case.[43]

(*5*) *Webber* v. *Pac. Power and Light Co.;* 242 Pac. (Wash.) 1104: In this case the claim of the plaintiff was to the effect that the water company failed to flush the dead end of a water main through a fire hydrant attached thereto, and that the water company had been lax in that regard. But, as certain other consumers on the same line did not become ill and, as the plaintiff had failed in certain technicalities of evidence, such as the obtaining of an insufficiently and inexpertly tested sample of such water, the plaintiff was defeated in her action for damages.

(*6*) *Ritterbusch* v. *City of Pittsburg;* 269 Pac. (Cal.) 930; 205 Cal. 84; 61 A.L.R. 448: In this case, decided in 1928, nineteen cases were consolidated for trial; and the respective plaintiffs recovered judgments against the City of Pittsburg for illness and death caused by typhoid fever contracted through the use of impure and unchlorinated water from the city mains. The pollution was due to a break-down of the chlorination plant for a period of approximately twelve hours.

(*7*) *Campbell* v. *City of Helena;* 16 Pac. (2d) (Mont.) 1: In this action plaintiff sued for damages in the sum of $10,000 for the alleged negligence of the city in permitting the domestic water supply to become polluted with typhoid bacilli. The lower court dismissed plaintiff's action on the ground that the plaintiff had failed to file a notice of injuries due to a "defect" in public works. The Supreme Court of Montana reversed the case and remanded it for trial, stating that the plaintiff had stated a cause of action and that the city was acting in a "private corporate capacity." It was held that the aforementioned claim statute did not apply to damages for illness contracted from drinking contaminated water furnished by the city.

(*8*) *Safransky* v. *City of Helena;* 39 Pac. (2d) (Mont.) 644: In this case it was alleged that the plaintiff had acquired typhoid fever from drinking city water which had become contaminated with coliform bacteria due to a break in the sewer pipes and a resultant seepage of sewage through the soil and into the water

[43] Roscoe *v.* City of Everett, 239 Pac. (Wash.) 831, *supra.*

pipe line. In granting judgment for the plaintiff, the court held that the city must exercise reasonable care and that the facts of contamination might be proved by circumstantial evidence. It was also held that the city was not immune from liability because the operation of a sewer system was carried on in a governmental capacity.

(*9*) *Stoker* v. *Ogden City;* 54 Pac. (2d) (Utah) 849: The injury here involved was alleged to be due to typhoid illness caused by water drawn into the city water mains from a stream known as "Wheeler Creek." Plaintiff's claim for damages was denied because of insufficiency of proof that the illness of the deceased was due to contamination from water delivered by the defendant city. In all such cases the burden of proof is upon the person claiming illness to be due to such contamination.

(*10*) *Cady Lbr. Co.* v. *Fain;* 65 Fed. (2d) (C.C.A. 9th) 644: The negligence alleged in this case was the maintenance of water for industrial use and water for domestic use in the same concrete sump, the two waters being separated from each other by a wooden partition. The Circuit Court of Appeals reversed the District Court's judgment for plaintiff and remanded the case to the District Court by reason of the admission of prejudicial evidence by the latter court.

(*11*) *Stubbs* v. *City of Rochester;* 148 N. Y. Supp. 804: In this case it was alleged that the city had permitted its domestic water supply to become polluted by river water, introduced into the domestic water system by the opening of a "check valve" by persons unknown. It was alleged that the city should have inspected the pipes from time to time and should have discovered this condition and the position of the check valve. A judgment for the plaintiff was reversed and a new trial granted because the appellate court determined that plaintiff's evidence was insufficient to show that his infection came from the water, which was admittedly contaminated.

(*12*) *Canoven* v. *City of Mechanicville;* 180 N. Y. Supp. 62: In this case the plaintiff sued on the theory of an "implied warranty" of wholesomeness, which warranty was allegedly breached by the city's supply of an impure water causing the disease of typhoid fever. The appellate court reversed the ruling of the lower court (which overruled the demurrer of the city) and sustained the demurrer on the ground that the furnishing of

water by a municipality was not a bargain and sale within the personal property law of the State of New York.

(*13*) *Green* v. *Ashland Water Co.;* 77 N. W. (Wisc.) 722: In this case the defendant company drew its water supply from a body of water into which was discharged the sewage of the city of Ashland. The plaintiff's intestate drank water drawn from such body of water and died from typhoid fever contracted therefrom. The Supreme Court of Wisconsin reversed a lower court judgment in favor of the plaintiff on the ground that the water works corporation was not responsible as an implied warrantor of the purity of the water it distributed and that the community as a whole had knowledge of the source of said water and of the fact that persons had previously become ill from drinking the water. The deceased, as an intelligent man, was held to have had such notice and, therefore, to have been guilty of contributory negligence.

(*14*) *Martin* v. *Springfield City Water Company;* 128 S. W. (2d) (Mo.) 674: This was an action against a water company for failure to furnish plaintiff with pure, safe and uncontaminated water for drinking purposes. It was alleged that the water company knew, or should have known, that the water was polluted and contaminated with disease-producing bacilli and had negligently failed to warn the plaintiff, as a member of the public, of the dangerous condition. A judgment of the lower court, for the plaintiff, was reversed and the case remanded for a new trial on certain technical grounds related to the improper introduction of evidence and the improper asking of hypothetical questions.

(*15*) *Georgia Power and Light Co.* v. *Baxter;* 171 S. E. (Ga.) 309: The negligence in this case was alleged to be the unlawful acts of the water company in permitting effluent from sewer pipes to seep into the reservoirs, cisterns and pipes maintained (in a broken condition) by the water company. The Court of Appeals of Georgia reversed a judgment of the lower court, for the plaintiff, stating that although there was a great deal of evidence as to possible sources of pollution of the public water system, it was not proved by the plaintiff that he contracted typhoid fever from the drinking of water supplied by the water company.

(*16*) *Stubbs* v. *City of Rochester;* 124 N. E. (N. Y.) 137: In this case there were two systems of water supply, one a potable supply from Hemlock Lake, known as the Hemlock System, and a second, the Holly System, pumped from the Genessee River for fire purposes in the business district. A check valve had been installed to prevent the water of the Holly System from entering the Hemlock System due to the greater pressure in the former system. An action was brought by the plaintiff for illness from typhoid fever allegedly contracted by reason of the contamination of the domestic water system through water discharged from the Holly System into the Hemlock system. The lower court found for the defendant, apparently upon the theory that the plaintiff had failed to sustain the burden of proof. The appellate court, however, reversed the decision of the lower court and granted a new trial, stating in its opinion that actual evidence of contamination had been introduced and that it was a jury question whether or not, with the increase of typhoid cases, this situation was due to the contamination of the city water.

(*17*) *Pennsylvania R. R. Co.* v. *Lincoln Trust Co.;* 167 N. E. (Ind.) 721: In this case there was a connection between the water system of a railroad company, which took water from a river near the source of sewage pollution, and the domestic water supply of the City of Fort Wayne. The plaintiff's intestate became ill with typhoid fever from the drinking of the city water, and it was proved that a negligent failure to close the shut-off valve between the two systems caused the pollution. It was held that the city was bound to use reasonable care to see that no impure water entered its mains; that plaintiff was not required to prove with absolute certainty that the drinking water was the source of the typhoid fever; and that it need not be proved by the plaintiff that the city had actual knowledge of the unwholesome water which was delivered to the home of the deceased. The city's petition for a rehearing was denied.[44]

(*18*) *City of Salem* v. *Harding;* 169 N. E. (Ohio) 457: In this case the city obtained its water from deep wells, from which the water was conducted by gravity to its reservoir. Close to the gravity line and paralleling it was an old sewer line with uncemented joints. After the construction of a new sewer line, the city health officer ordered the plugging up of the old line.

[44] 170 N. E. 92.

This order was carried out with result that sewage backed up in the old line, overflowed through the surrounding soil, and entered the gravity line of the water company.

The minor daughter of the plaintiff became ill from typhoid fever which occurred in the course of a serious epidemic of gastro-enteritis and typhoid fever, traceable to the aforementioned pollution. The City of Salem was held liable in damages for this illness.

(*19*) *Buckingham* v. *Plymouth Water Co.;* 21 Atl. (Pa.) 824: In this case a flood, due to the break-up of ice and the thawing of ground near a dam and reservoir caused certain dejecta from a typhoid patient to be carried into said reservoir and a typhoid epidemic resulted therefrom.

Plaintiff sued for the death of two of his children and the illness of others, but the court held that there was no evidence that the water company knew, or should have known, of the illness, and that it had not been negligent since it had inspected the banks of the river shortly prior to the occurrence of the epidemic.

(*20*) *Peffer* v. *Pennsylvania Water Co.;* 70 Atl. (Pa.) 870: This was an action by citizens of the Borough of Wilkinsburg to force the water company to supply a pure and wholesome water free of contamination (including bacteria and bacilli). The court decreed that, within three months from the date of such decree, the water company should file a statement of the steps it had taken by filtration, or otherwise, to furnish a sufficient supply of reasonably pure and wholesome water.

(*21*) *Hayes* v. *Torrington Water Co.;* 92 Atl. (Conn.) 406: This was an action to recover damages allegedly caused by defendant's negligence in supplying water infected with typhoid germs. The lower court gave a judgment of non-suit, which the appellate court reversed in ordering a new trial. The defendant water company took its supply from a watershed upon which were located several highways and farm houses. The appellate court found that there was ample evidence of contamination by typhoid bacilli and of the fact that these came from the watershed in question. The court further held that, although the private water company was not a guarantor of the purity of the water, or its freedom from infection, it was bound to use reasonable care to ascertain whether there was a reasonable probability that the supply might be, or become, infected,

and to take precautionary steps and measures designed to protect the community from the risk of such infection.

(*22*) *Jones* v. *Mt. Holly Water Co.;* 93 Atl. (N. J.) 860: This was an action by plaintiff for damages due to an illness of typhoid or paratyphoid fever attributable to drinking water supplied by the defendant company. There was evidence that the defendant had known of this pollution for a period of three and one-half years and that twenty-three cases of typhoid fever in a population of 6,000 had occurred from December 1, 1911 to February 26, 1912. This was held by the court as sufficient evidence not only of negligence on the part of the water company but of an entire lack of reasonable care in serving potable drinking water.

(*23*) *Hamilton* v. *Madison Water Co.;* 100 Atl. (Me.) 659: In this case it was clearly shown that ample opportunities for contamination existed close to and in the immediate vicinity of, the reservoir which supplied the Town of Madison with water, by gravity. Plaintiff, having become ill with typhoid fever from drinking polluted water from the reservoir, was given a judgment of $1,500. The judgment was affirmed by the appellate court.

(*24*) *Boguski* v. *City of Winooski;* 187 Atl. (Vt.) 808: In this case, polluted river water entered the domestic water system through a bypass used for increasing water pressure for fire fighting purposes—the valve used in connection therewith having been left open negligently. Judgment for the plaintiff was affirmed by the Supreme Court of Vermont, it being stated that circumstantial evidence could be resorted to, to sustain a verdict against the city for death by typhoid allegedly caused by drinking polluted city water. It was further held that, although the pollution entered from a system maintained in a governmental capacity, this fact did not relieve the city of its liability in a proprietary capacity.

Although it would serve no useful purpose to give the name of the case, or to designate the state, involved in this comment, attention is called to the fact that one of the cases involving personal injury from typhoid fever due to waste contamination is *not* reported in the "state reports," but appears only in the "Reporter Series" of the West Publishing Company. At the beginning of the report of said case appears the caption *"Not to Be Published in State Reports."*

Thus it appears that, in at least one instance, a municipal water company (and the state in which it was located) was either ashamed or afraid of the publicity which might result from the reporting of such a case.

b. Cases of Amebic Dysentery: The following cases deal with amebic dysentery and other similar diseases, resulting from polluted water.

(*1*) *Burns* v. *Employer's Liability Assurance Corp.;* 16 N. E. (2d) (Ohio) 316: Although this is not a case involving the question of the liability of a water company for death or injury arising out of the drinking of polluted water, it does give an insight into the type of injury which may result from such source and has a special interest in that the injury in question arose out of the Congress Hotel amebic dysentery outbreak in the summer and fall of 1933. Here, the particular question was whether a policy of Workmen's Compensation Insurance covered death from amebic dysentery contracted from drinking polluted water where the policy covered "bodily injuries sustained during the term of this policy, solely and independently of all other causes through accidental means."

It was held that such death was not included within the coverage. The case, however, was, and is, a "gold mine" of citations both of insurance cases and cases involving injuries or death from disease-bearing water. There is also a rather technical discussion of the nature of amebic dysentery.

(*2*) *Ritterbusch* v. *City of Pittsburg;* 269 Pac. (Cal.) 930; 205 Cal. 84; 61 A. L. R. 448:[45] This case is cited in this section by reason of the fact that, in addition to the epidemic of typhoid fever involved, there was also an epidemic of dysentery occurring at about the same time and which resulted in a number of cases of serious illness.

(*3*) *Carey-Reed Co. Inc.* v. *Farmer;* 192 So. (Miss.) 48: The corporation used large amounts of water from the city water mains and from a bayou, in connection with the building of roads, the water from the latter source being supplied under greater pressure by a pump. As a result of this operation, polluted bayou water was forced into the city water supply, due to the absence of a safety valve. As a result the plaintiff became severely ill with a case of gastro-enteritis with which he was ill for a period of 14 months and from which he suffered consider-

[45] See also Case (6) in the previous section.

able after-effects of abdominal pains and nausea. A judgment in favor of plaintiff for $3,000 was affirmed by the Supreme Court of Mississippi.

c. Other Types of Illness Due to Contaminated Water:

(1) Horton v. *Inhabitants of No. Attleborough;* 19 N. E. (2d) (Mass.) 15: In this case the appellate court sustained the objections of plaintiff to certain refusals of the trial judge to instruct the jury after a verdict for defendant. The action was one for (a) breach of warranty that the water would be fit for drinking and for (b) negligence in supplying impure water.

The appellate court held that there was evidence of a knowledge on the part of the town that its water was high in carbon dioxide content; that the plaintiff's pipes were of lead composition and that the effect of carbon dioxide and water upon said lead pipes was to produce a type of lead poisoning from which the plaintiff became ill.

2. Liability Arising From Negligent Inspection and Maintenance

Although the writer has found no health or water supply case bearing on this particular point, attention is called to the case of *Hoffman* v. *Leavenworth Light, Heat & Power Co.* (138 Pac. (Kansas) 632) in which it was pointed out (at p. 636): ". . . in order, therefore, to hold the seller liable, it must appear that it continued to furnish and turn on the dangerous current *after knowing that the purchaser had permitted the equipment to become defective.* From the time of acquiring such knowledge the seller's contract duty cannot be required save on condition that such defect be remedied, for otherwise it must thenceforward furnish a dangerous force, knowing that life and limb may be imperiled by reason of such defect, which neither a contract nor the law nor the common instincts of humanity could require of anyone." [Author's italics.]

This brings to mind a possible dual warning to water companies, advising them not to be too free with their inspections of the premises of private consumers, and that if, and when detailed inspections seem advisable or desirable, such inspections be thorough. If, at the time of such inspection, an unapproved fixture or a dangerous condition is found to exist, the consumer should be required to replace or repair the fixture immediately or to remove or abate the condition.

With respect to the question of entry on the consumer's premises, attention is called to the case of *Breker* v. *Lakewood Water Co.* (174 Atl. (N. J.) 478). In this case it was said:

"Plaintiff sued to recover damages because of the theft of some of her property by persons unknown. It appears that the *defendant*, through its servants, *entered the plaintiff's premises to remove a water meter.* They had authority so to do whenever for any reason the service should be terminated. The house was vacant, the weather was excessively cold, and there was danger of freezing. *It seems unnecessary to consider how the entry was made, or whether the subsequent closing of the house was effective.* The case went to the jury on the theory that the closing of the house, after the removal of the meter, had been done in a negligent manner, and that, therefore, the defendant company was liable for the unlawful burglaries committed by parties unknown. [Author's italics.]

"The proofs are satisfying that the closing was as effective as it had previously been. The rule of law is: 'Defendant's negligence is too remote to constitute the proximate cause where an independent illegal act of a third person, which could not reasonably have been foreseen, and without which such injury would not have been sustained, intervenes.' (45 Corpus Juris, 936.) It could not be foreseen that the burglaries would occur by reason of anything the defendant was shown by competent proof to have done or failed to do."

3. Liability Arising From Discrimination in Service and/or From Discontinuance of Service.

(1) Ten Broek et al. v. *Miller;* 216 N. W. (Mich.) 385: In this case a resort company, a semi-public utility, was held liable to the plaintiff in damages for a discontinuance of service by the company, purportedly based upon the failure of plaintiff to install a septic tank. Although the company had a rule and regulation with respect thereto and a further rule and regulation stating that, for failure to comply with such rules and regulations, the company would have the right to decline service, the court held that the installation of a septic tank was a matter purely "collateral" to the furnishing of light and water; and that such a rule, therefore, was unreasonable.

The court stated, however, that: "If plaintiff were violating a rule of the state health department, he could be proceeded against for its infraction in the proper forum. This would be a more orderly way [in the opinion of the court] of disposing of the dispute than for defendant [the resort company] to substitute itself for a court and punish plaintiff by shutting off his water and light."

A judgment for $1,000.00 was held not to be excessive.

(*2*) *Alabama Water Co.* v. *Barnes;* 82 So. (Ala.) 115: In this case the court allowed a judgment of $200 for "inconvenience and annoyance," plus damages, for the necessity of procuring water in buckets from a well one block and a half from plaintiff's home.

(*3*) *Bessemer Water Works* v. *Murphy;* 60 So. (Ala.) 533: In this case it was held that, where a water consumer violated rules of the water company to the effect that no water should be furnished by a consumer to neighbors and that the hydrants should be kept in such a condition as not to leak, the water company was entitled to discontinue service under its rules and regulations (in the absence of an ulterior motive on the part of said water company).

4. Liability Generally

a. The Control of Sanitation as a Governmental Function: It seems to be well settled that the administration and control of sanitation for the public health of a city is a governmental function and that, when a city is exercising such power, it is not liable for injuries inflicted through the negligence of its officers and employees.[46]

b. Applicability of Doctrine of res ipsa loquitur: It was held in the case of *Buffums* v. *City of Long Beach*,[47] that when plaintiff's proof (in a case involving the breaking of a water main) raised the presumption of negligence, under the applicable doctrine of *res ipsa loquitur*, this presumption could only be overcome by proof that the defendant city had in no wise been guilty of negligence and that where there was a decided conflict in the evidence, the plaintiff was given a judgment.

On the other hand, it has been held in the case of *Minn. General Elec. Co.* v. *Cronon*,[48] that the doctrine of *res ipsa loquitur* is at best uncertain and should not be applied except where it not only supports the conclusion contended for, but also reasonably excludes all others. It was further held that such doctrine is limited to cases of absolute duty or to an obligation practically amounting to that of an "insurer" and that said doctrine: ". . . cannot be invoked to hold liable an

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[46] Ballard *v.* City of Ft. Worth, 62 S. W. (2d) (Tex.) 594 at 595; Jones *v.* City of Texarkana, 100 S. W. (2d) (Tex.) 198 at 201; Gotcher *v.* City of Farmersville, 139 S. W. (2d) (Tex.) 361 at 363.

[47] 111 Cal. App. 327 at 333.

[48] 166 Fed. (C. C. A. 8th) 651.

electric company furnishing a current of electricity to a private house, connecting with inside wiring owned by and under the exclusive control of the proprietor of the building, for an injury resulting directly from the imperfect insulation and condition of such inside wiring, merely because the electric company is producing and furnishing the dangerous and subtle element of electricity under a contract with the owner of the building."

c. Liability Arising From Negligent Use of Boiler Equipment, etc.:

(*1*) *Bourie* v. *Springville Water Co.;* 8 Cal. App. 588: In this case the water company installed a check valve to a boiler in the plaintiff's laundry. It was alleged that this action of the water company caused excessive pressure in the boiler which, in turn, caused an explosion that injured the plaintiff. It was held that the plaintiff had been using the water company's water pressure improperly in connection with the operation of the boiler; that he had not provided safety appliances therefor; and that there was no negligence on the part of the water company in installing said check to preserve the purity of the water for use of other customers. It was further held that said water company was not guilty of negligence in assuming that plaintiff would discharge his duty of equipping his boiler with safety appliances for relieving the pressure.

(*2*) *Harmon* v. *M. H. Sherman Co.;* 29 Cal. App. (2d) 580: In this case the plaintiff was burned by an ascending stream of scalding water and steam while flushing a toilet which was installed and maintained in violation of a city ordinance prohibiting the use of such a fixture without providing a flush tank between the general water supply system and the toilet. The negligent operation of a hot water heater by the defendant caused hot water and steam to back up into the main water supply. Judgment was entered for the plaintiff in the sum of $16,703.50.

(*3*) *Seiden* v. *Passaic Valley Water Commission;* 199 Atl. (N. J.) 420: In this case the plaintiff recovered damages against the water company due to injury to his plumbing system by excessive sand in the water supplied to said plaintiff. This was another instance in which the court applied the rule or doctrine of *res ipsa loquitur.*

d. General Failure to Inspect or Control Service Equipment Properly:

(*1*) *Indianapolis Water Co.* v. *Schoenemann;* 20 N. E. (2d) (Ind.) 671 at 675: It was held here that the water company was

liable for an injury (due to plaintiff's tripping over a curb box) resulting from its negligence in respect of an instrumentality which was in the joint control and possession of said company and the consumer, even though the company was not the owner thereof, since (stated the court) "liability for negligence does not depend on ownership."

(2) *Seeley* v. *City of Norwalk;* 4 N. E. (2d) (Ohio) 403: In this case the city was held liable for damages resulting from leaks in service pipes leading to the mains of a municipally owned water plant, when, after notice (and notwithstanding the fact that the service pipes belonged to the consumer), the city did not take steps or use reasonable care in correcting said imperfections.

(3) *Palmer Adv. Service* v. *Grinnell;* 285 N. Y. Supp. 647: Here the village was held liable for the flooding of plaintiff's premises when (so the court stated) the village turned water from its main pipe into the supply system of plaintiff's premises at a time when the village knew, or should have known, that the latter pipe was so inadequately constructed as to be insufficient to withstand the pressure of such water.

e. Cases Somewhat Relaxing the Rigidity of the Duties of Water Companies:

(1) *City of Richmond* v. *Hood Rubber Products Co.;* 190 S. E. (Vir.) 95: In an action for damage caused by water escaping from a defective meter, it was held that the municipality in supplying water was not dealing with a commodity which is dangerous in itself and that said municipality was required to exercise only ordinary care. It was also held that, although the doctrine of *res ipsa loquitur* could apply in such cases, it was inapplicable in the present case due to the positive testimony introduced as to the cause or causes of the damage.

(2) *de Rochemont* v. *Camden & Rockland Water Co.;* 152 Atl. (Me.) 534: In this case it was held that the water company did not owe the consumer the duty of guarding against the consumer's negligence in failing to have a check valve between his water tank and the street main of the water company. The consumer's failure to have such a check valve was held to be contributory negligence preventing recovery for the collapse of the water tank when the water company shut off the water in the street main. It was indicated, however, that the water company had been somewhat negligent in its failure to inspect the consumer's appliances.

f. Liability of City From Failure to Enforce Laws: In the case of *Mayne* v. *Curtis*,[49] it was held that a city is not liable for a failure to exercise powers of a purely governmental character.

g. Liability of City for Acts of Officers in Enforcing Health Laws: Insofar as a municipality undertakes the duty of making and enforcing regulations for the conservation and promotion of the public health, it is in the performance of governmental functions, and it is generally held that its officers are not agents for whose action or inaction it is answerable.[50]

(*1*) *Hagerman* v. *City of Seattle;* 66 Pac. (2d) (Wash.) 1152: It was held here that the safeguarding of the public health is a "governmental function" and that a municipality is not liable for the torts committed by health officers and their agents in the performance of their duties. Such exemption covers not only immediate activities and facilities asserted and used, but also those reasonably incident and appropriate to the operation of the health department.

(*2*) *City of Okmulgee* v. *French;* 77 Pac. (2d) (Okla.) 712: In this case the city sanitary inspector, acting under orders and directions of the county health officer, caused a house to be demolished. It was held that the city was not liable, first, because the function was a governmental function, and, secondly, because the inspector acted without the scope of his employment.[51]

To the contrary, it was held in the case of *Adams* v. *City of Toledo*,[52] that even in the performance of a "governmental act," if a municipality is guilty of active wrongdoing, there is no immunity from damage. In this particular case the city destroyed the building of the plaintiff by a fire which the city started in, and which spread from, certain unoccupied buildings which constituted a public nuisance.

h. Liability of the City in Action by State Against City:

(*1*) *State Bd. of Health* v. *Village of St. Johnsbury;* 73 Atl. (Vt.) 581: Here it was held that the state board of health, as a general supervisor of the water supply of the state, could bring a proceeding against a village to prohibit the furnishing and use, by the

[49] 126 N. E. (Ind.) 699-700.

[50] 25 Am. Jur. Health 295-6, §16.

[51] Village of Verdon *v.* Bowman, 97 N. W. (Neb.) 229; Lowe *v.* Conroy, 97 N. W. (Wisc.) 942; Roumbos *v.* City of Chicago, 163 N. E. (Ill.) 361 at 365; Pemberton *v.* City of Greensboro, 181 S. E. 258 at 261.

[52] 96 Pac. (2d) (Ore.) 1078 at 1080.

village and its inhabitants, of certain unpotable waters for domestic purposes.

(2) *People* v. *City of Springfield;* 19 N. E. (2d) (Ill.) 598 at 603–6: Here it was held that the legislature may compel a municipality to perform any duty which relates to the general welfare and security of the state, although performance of the duty will create a debt to be paid by local taxation.

(3) *State Bd. of Health* v. *Comm. of the Town of Louisburg;* 91 S. E. (N. C.) 1019: Here it was held that the state board of health could enforce a state statute against a town to prohibit the discharge of sewage into a river flowing through the town.

On the other hand, it was decided in *Mayor, etc., of the City of Salem* v. *State Bd. of Health*[53] that the city could bring a bill against the state board of health to force a revision of its orders with respect to the discharge of sewage into Salem Creek, under allegations that there was no showing that the pollution of water thereby affected the water supply of said town.

i. Liability of Health Officer or Board: The general rule is that incorporated boards of health which are invested by statute with functions of a public nature, to be exercised for the public benefit, are not liable for injuries resulting from the performance of their official duties in the promulgation and enforcement of health regulations, so long as they act within the limits of their authority and discretion, in the absence of any statutory provision imposing said liability.

In accordance with established principles governing the liability of public officers for injuries inflicted in connection with the performance of their official duties, the general rule is that members of boards of health and health officers are not personally liable for injuries resulting from an erroneous exercise of their judgment or discretion, where they act in good faith, within the limits of their authority.[54] The rules exempting them from liability are not, however, extended to relieve them when they act without the scope of their authority or act with negligence amounting to malice.[55]

(1) *Valentine* v. *City of Englewood;* 71 Atl. (N. J.) 344: Here it was held that the members of a board of health acting in the performance of public duty under a public statute to prevent

[53] 74 Atl. (N. J.) 696.

[54] 25 Am. Jur. Health 295, §16.

[55] 25 Am. Jur. Health 295, §17.

the spread of an infectious and contagious disease were not personally liable in a civil action for damages arising out of their acts in establishing a quarantine, even where a disease did not actually exist; since, as it appeared from the evidence, they acted in good faith.

(*2*) *Crayton* v. *Larabee;* 116 N. E. (N. Y.) 355: It was held that, for a mere error in judgment in establishing a quarantine, a health officer cannot be held liable; but that, for any unreasonable, arbitrary, malicious or partial action or actions in excess of his authority, he would be personally liable.

(*3*) *Panther* v. *Dept. of Agr. of Iowa;* 234 N. W. (Iowa) 560: Under the state bovine tuberculosis statutes, it was held that if the tester wrongfully destroys an animal, which, in fact, is not tubercular, the owner of the animal has a remedy for his loss against said officer.

(*4*) *City Council of Augusta* v. *Loftis;* 118 S. E. (Ga.) 666: In this case, an interlocutory injunction was granted against the City Council of Augusta and its plumbing inspector on the ground that the inspector arbitrarily and unreasonably required the installation of "drum" traps for draining bath tubs when "P traps," sought to be installed by the petitioner, were admittedly equally satisfactory devices for that purpose. The decision of the inspector was held to be obviously arbitrary and unreasonable.

5. Potential Liability

It is undoubtedly true that thousands of cases involving a potential liability on the part of the city or of the water utility never reach the trial courts and/or the appellate courts of the several states for several reasons, for instance: (1) the injured party may not realize the existence of a cause of action; (2) he may be advised by counsel that the facts supporting such a liability are too difficult of proof; or (3) the water utility and/or municipality may settle out of court either prior to the commencement of an action, prior to the bringing of such an action to trial, or prior to the taking of an appeal from a judgment of the lower court in his favor.

The writer, therefore, believing that it will be of some interest to the reader to obtain the citation of a few such instances in and about the City of Los Angeles, the State of California, and elsewhere, in which potential law suits were "in the making," has set forth here a brief summary of a few such case histories.

a. Case Histories in and About the City of Los Angeles: During the past four or five years there have been several cases of back-flow and/or back-siphonage brought to the attention of R. F. Goudey, as the Chief Sanitary Engineer of the Bureau of Water Works and Supply of the Department of Water and Power in Los Angeles. These cases (where such back-flow or back-siphonage has actually occurred) were discovered through complaints made by water consumers regarding unaesthetic conditions and involving discomfort or illness alleged to be due to the drinking of water having a bad taste or a bad odor and/or containing discoloring matter, such conditions being traceable in many instances to faulty action of plumbing and water fixtures and pipes. Although there have been a number of cases of illness caused by such conditions, no known fatalities have resulted therefrom.

A partial list of the aforementioned cases is given herewith:

(*1*) *Case 1:* Contents of toilet bowls were sucked back into water pipes when a street main was shut off to repair a broken fire plug. No known illness.

(*2*) *Case 2:* Improperly designed plumbing and water supply system caused sewage pollution to enter the drinking water system. This was proved by bacterial analysis and pressure-gage records. No known illness.

(*3*) *Case 3:* Cross-connection to boiler feed permitted pollution of drinking water, causing ten cases of gastro-enteritis and severe diarrhea. The cross-connection was voluntarily eliminated and no further trouble has been experienced.

(*4*) *Case 4:* Back-siphonage occurred from metal treating vat into drinking fountain. Water was proved by analysis to be contaminated. Five cases of nausea and diarrhea.

(*5*) *Case 5:* Contents of oakite tank drained into the water system. Employees complained of the quality of the drinking water.

(*6*) *Case 6:* Carbon dioxide entered water system through a leaky check valve. High concentration of copper. No illness reported.

(*7*) *Case 7:* Water from surface drainage sumps was pumped into the water system. Residential section district affected. No sickness reported.

(*8*) *Case 8:* Sulfur dioxide entered water system through leak in line. 1,440 p.p.m. in water in roof tank. Employee's face slightly burned.

(*9*) *Case 9:* $50.00 worth of water discharged into the sewer, with reversal of flow at times when water pressure was low. No sickness reported.

(*10*) *Case 10:* Leak in refrigerant coil allowed gas to flow into water system. No illness reported.

(*11*) *Case 11:* Backwash line from drinking water filter hooked direct to the sewer. The sewer was clogged and sewage backed up to the filter.

(*12*) *Case 12:* City water discharged from refrigerator cooling system into flooded urinal.

(*13*) *Case 13:* Direct city water connection to high pressure boiler. No check valve in the line. Steam came out of drinking fountain located two floors above.

In four Los Angeles Municipal Court cases at San Pedro, Calif., in December, 1932, four operators of plants for the handling of fish and fish by-products pleaded guilty to violations of the Los Angeles Municipal Code provisions regarding cross-connections and received fifteen-day sentences which were suspended upon the abatement of the nuisances in question.

b. Case Histories in the Vicinity of Los Angeles and Elsewhere in the State of California: The following are two of the more important of such case histories that have come to the author's attention:

(*1*) *Case 14:* Contents of storage tanks filled with coconut oil flowed by gravity into a water system. No illness reported.

(*2*) *Case 15:* Oil, mud and salt water were forced into a water system by gas pressure. Property damage sustained by city. No illness.

c. Two Important Case Histories in Chicago: Particular attention is hereby called to two case histories in Chicago, since they are particularly illustrative of the tremendous hazard involved in the service and supply of polluted water:

(*1*) *Case 16:* Amebic dysentery epidemic in Congress and Auditorium Hotels spread by back-siphonage of polluted water from plumbing fixtures into the drinking water supply system. Approximately 1,600 cases with 67 deaths, affecting over 200 cities. This occurred during the World's Fair in 1933, and is probably the most outstanding case of this type known in history.

(*2*) *Case 17:* Stockyards fire of May 19, 1934, caused 69 cases of typhoid, 5 cases of paratyphoid, and many cases of diarrhea.

Extremely heavy demand placed on street mains by fire pumps caused a reduced pressure in the mains, thus causing back-siphonage of plumbing fixtures in adjacent buildings.

d. Comments of the Press Relative to Cross-Connection Conditions: For the subject matter and the editorial trend of the comments relative to cross-connections and back-siphonage made, from time to time, in some of the leading newspapers of the country, attention is called to an excellent summary which appears in the paper by R. F. Goudey, immediately preceding in this JOURNAL.[56]

IV. Decisions Re: Promulgation and Administration of Health Laws, Rules and Regulations

A. Bases of the Right of Police Power

All health laws, rules and regulations are promulgated and enforced pursuant to the "police power" of the state or of some political subdivision thereof, such as a county, city and county, municipality or district.[57]

B. Exercise of the Police Power Generally

Subject to certain constitutional inhibitions, a political subdivision, in enforcing any law promulgated pursuant to the police power, may exercise a wide discretion. It is presumed that, in imposing such an act, the legislature was motivated by good and sound considerations, that the enforcement of the act is reasonably necessary, and that the provisions thereof are constitutional and reasonable.

1. Regulation of Plumbing and Other Similar Matters Relating to Health, Safety and Welfare

The regulation, by ordinance, of methods and devices for the conveyance of sewage from private dwellings in municipalities is recognized as an exercise of that branch of the police power which pertains to public health; and the word "plumbing" as used in such an ordinance is held to include pipes, fittings and fixtures for the conveyance of such sewage.[58] It has been held that the installation of rain-water leaders, unconnected with any waste, drain, or soil pipes, was not plumbing work within an ordinance prohibiting any plumbing work in city without the filing of a plan and the obtaining of a permit; and that plumbing is the installing, altering, or repairing

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[56] See p. 405 et seq. of this issue of the Journal.

[57] See Part II. B. of this paper, p. 499 et seq.

[58] In re Nicholls, 74 Cal. App. 504, at 507–8.

of pipes, tanks, faucets, valves, and other fixtures through which gas, water, waste, or sewage is conducted and carried.[59]

It has been held, too, that a municipality, by ordinance, may prescribe the plumbing regulations for either water or sewage systems, the plans for such regulation to be approved by the state department of health.[60]

The statute relating to the licensing of plumbing and heating contractors extends only to those who contract to install or restore entire "plumbing" and heating "systems" for buildings, or to make substantial alterations thereof; but even if the term "plumbing" is construed not to refer solely to plumbing systems, the statute is inapplicable to a journeyman plumber who furnishes no materials, supplies or fixtures, but merely works at his trade as a plumber for an hourly wage.[61]

In further adjudication on the subject of plumbing, it has been held that: the act of attaching an electric heater to the water system is an act of plumbing;[62] the word "person" used in a plumbing ordinance includes a corporation engaged in the plumbing business;[63] a license fee upon engaging in the trade of plumbing, constituting a privilege tax, is lawful;[64] and the state and its subdivisions may regulate plumbing (including the material and size of pipe), the licensing of plumbers, and the promulgation of provisions for inspection of plumbing installations.[65]

Special attention is called to the case of *Health Dept. of the City of N. Y.* v. *Rector, etc., of Trinity Church.*[66] In this case, the so-called

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[59] State *v.* Hahnel, 108 Atl. (Me.) 755.

[60] State *v.* Prescott, 151 Atl. (Me.) 426.

[61] State *v.* Mitchell, 7 S. E. (2d) (N. C.) 567; City of St. Louis *v.* Hoevel Real Estate and Building Co., 59 S. W. (2d) (Mo.) 617 at 618.

[62] Commonwealth *v.* Leswing, 5 Atl. (2d) (Pa.) 809-811.

[63] Attorney General *v.* Union Plumbing Co., Inc., 16 N. E. (2d) (Mass.) 89 at 90-91.

[64] Roach *v.* City of Durham, 169 S. E. (N. C.) 149 at 150.

[65] Kleinhein *v.* Board of Comm., 157 Pac. (Kan.) 1190; City of Spokane *v.* Latham, 42 Pac. (2d) (Wash.) 427 at 428; Beltz *v.* City of Pittsburgh, 61 Atl. (Pa.) 78; City of New Castle *v.* Withers, 139 Atl. (Pa.) 860; Commonwealth *v.* Beaulieu, 99 N. E. (Mass.) 955; Commonwealth *v.* McCarthy, 114 N. E. (Mass.) 287; Seignious *v.* Rice, 6 N. E. (2d) (N. Y.) 91 at 92; Felton *v.* City of Atlanta, 61 S. E. (Ga.) 27; Trewitt *v.* City of Dallas, 242 S. W. (Tex.) 1073; Mayor, etc. of City of Vicksburg *v.* Mullane, 63 So. (Miss.) 412; State *v.* Lutz, 147 So. (Ala.) 429, 431.

[66] 39 N. E. (N. Y.) 833.

"Tenement House Act" required that tenement houses provide a supply of water on each floor when so directed by the board of health, and prescribed a penalty for a failure to comply with its requirements. It was held, not only that such act was a valid exercise of the police power of the state, but that the mere fact that it would cost a reasonable sum to comply with the order of the board of health was no objection to the legality of the act and did not render it unconstitutional.

Although this is one of the leading cases in the United States with regard to the setting forth of the principles lying behind the exercise of the police power, it would serve no useful purpose here to quote extensively from it. It is interesting to note, however, that the court observed, in passing, with respect to the use of the public water supply, as follows:

". . . The water is brought into the city so that it may be used in every house and building within its limits; and although we may, and indeed must, admit that no health law could practically be enforced which should provide that every individual inhabitant of the tenement houses should use the water, yet we think it is perfectly clear that facilities for the use of the water will almost necessarily be followed by its actual use in larger quantities and more frequently than would be the case without such facilities, and to the great benefit of the health of the occupants of such houses. Those occupants require it more even than their more favored brethren, living in airy, larger, more spacious, and luxurious apartments. Their health is matter of grave public concern. The legislature cannot, in practice, enforce a law so as to make a man wash himself; but, when it provides facilities therefor, it has taken a long step towards the accomplishment of that object. That dirt, filth, nastiness in general, are great promoters of disease; that they breed pestilence and contagion, sickness and death—cannot be successfully denied. There is scarcely a dissent from the general belief on the part of all who have studied the disease that cholera is essentially a filth disease. The so-called 'ship fever' or 'jail fever' arises from filth. Most diseases are aggravated by it. That opportunities—conveniences—for the use of water in these tenement houses will unquestionably tend towards, and be followed by, more cleanly living on the part of the occupants of those houses, cannot, it seems to me, admit of any rational doubt; and, if so, then the law which provides, at a reasonable cost, for the furnishing of such facilities, is plainly and honestly a health law.

"The learned counsel for the defendant asks where this kind of legislation is to stop. Would it be contended that the owners of such houses could be compelled to furnish each room with a bath tub, and all the appliances that are to be found in a modern and well-appointed hotel? Is there to be a bath room and water closet to each room, and is every closet to be a model of the very latest improvement? To which I should answer, certainly not. That would be so clearly unreasonable that no court, in my belief, could be found which would uphold such legislation, and it seems to me equally clear that no legislature could be found that would enact it. The tenement house in New York is a subject of very great thought and anxiety to the residents of that city. The number of people that live in such houses; their size; their ventilation; their cleanliness; their liability to fires; and the exposure of their occupants to contagious diseases, and the consequent spread of the contagion through the city and the country; the tendencies to immorality and crime where there is very close packing of human beings of the lower order in intelligence and morals—all these are subjects which must arouse the attention of the legislator, and which it behooves him to see to, in order that such laws are enacted as shall directly tend to the improvement of the health, safety, and morals of those men and women that are to be found in such houses. Some legislation upon this subject can only be carried out at the public expense, while some may be properly enforced at the expense of the owner. We feel that we ought to inspect with very great care any law in regard to tenement houses in New York, and to hesitate before declaring any such law invalid, so long as it seems to tend plainly in the direction we have spoken of, and to be reasonable in its provisions. If we can see that the object of this law is without doubt the promotion or the protection of the health of the inmates of these houses, or the preservation of the houses themselves, and consequently much other property, from loss or destruction by fire, and if the act can be enforced at a reasonable cost to the owner, then, in our opinion, it ought to be sustained."[67]

In 1901 the "Tenement House Act" was amended to provide that all "school sinks" in existing tenement houses, in cities of the first class, be removed and replaced by "water closets," and that these water closets be properly connected to sewers with individual "traps" and properly connected "flush tanks." Citing the case of *Health Dept.* v. *Rector, etc., supra*, the Court of Appeals of the State of

[67] Ibid., p. 839.

New York held, in the case of *Tenement House Dept.* v. *Moeschen*,[68] that this was a valid exercise of the police power and a forward step in health legislation.

An ordinance of the city of Valdosta, Ga., of an import similar to that in the *Moeschen* case, and passed in 1909, was upheld by the Supreme Court of the United States in the case of *Hutchinson* v. *City of Valdosta*.[69]

2. Reasonableness of Health Regulations

Though the obligations of contracts must yield to a proper exercise of the police power, and though vested rights cannot inhibit the proper exertion of the power, it must be exercised for an end which is, in fact, public, and the means adopted must be reasonably adapted to the accomplishment of that end and not arbitrary or oppressive.[70] A police regulation for the protection of the public health will be sustained if by any fair construction it has a tendency to effect its object.[71] The legislature, however, cannot make reasonable a regulation which is, in fact, unreasonable.[72]

Before a court may appropriately pronounce invalid an attempted legislative exercise of a police power, it must be able to say, in its judicial knowledge, that such legislative body could not have any reasonable ground for believing that the regulation in question, if enacted, was a necessary measure of protection to the public health.[73] No mathematical formula nor interchanging yardstick exists by which, in all circumstances, the validity of a statute can always be confidently determined, but every case must be determined upon its own circumstances.[74] The power of the state to prohibit the use of property or courses of conduct injurious to the health, comfort, safety, morals and welfare of society, must find its basis in the doctrine of the overruling necessity or must bear some substantial relation to the public good.[75]

When a classification is made by the legislature [in enacting a

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[68] 72 N. E. (N. Y.) 231.

[69] 57 L. Ed. 520, 522 23.

[70] Treigle *v.* Acme Homestead Assn., 80 L. Ed. (U. S.) 391; 101 A. L. R. 1284 at 1288.

[71] In re Gray, 206 Cal. 497 at 502; New Orleans *v.* Southern Auto Wreckers, 192 So. (La.) 523 at 527; Ex parte Clark, 140 S. W. (2d) (Tex.) 854 at 856.

[72] Woolf *v.* Fuller, 174 Atl. (N. H.) 193 at 196.

[73] Skaggs *v.* City of Oakland, 57 Pac. (2d) (Cal.) 478 at 480.

[74] McSweeney *v.* Equitable Trust Co., 198 Atl. (N. J.) 529 at 532-33.

[75] Chicago Park District *v.* Canfield, 19 N. E. (2d) 376 at 378.

health law] and such classification is challenged on the ground that it results in discrimination, there is, if any state of facts can reasonably be conceived that would sustain it, a presumption of the existence of that state of facts; and one who assails the classification has the burden of showing by resort to common knowledge—or other matters [which may be judicially noticed], or to other legitimate proof, that the action is arbitrary. And if the evidence, or conclusions drawn therefrom, leaves it fairly debatable as to whether there is a reasonable basis for classification, the courts may *not* override the legislative determination.[76]

In the exercise of its police power, the city may regulate, or even prohibit nuisances which have already been decreed such, and may use every reasonable expedient for the preservation of the safety and comfort of the city's inhabitants to protect them from those conditions *which may reasonably be anticipated to result.*[77]

The regulation of the use, and the alteration, of existing buildings are thus within the purview of the police power.[78]

The fact that the enforcement of a police power provision may result in *individual hardship* is no constitutional objection to its exercise. This applies to the use of private property and to corporations as well as to private individuals.[79] It has been held, however, that a particular ordinance may be valid in its general aspects, and yet, when applied to a particular piece of property and/or to a particular set of facts, may be so arbitrary or unreasonable as to result in the confiscation of property; and that, as to such particular piece of property, such ordinance is void. The court, in determining such validity or invalidity, may take into consideration the relative costs to the individual as contradistinguished from the relative injury or cost to the public.[80]

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[76] S. H. Kress & Co. *v.* Johnson, 16 Fed. Supp. (D. C. Colo.) 5 at 8–9.

[77] In re Mathews, 58 Cal. App. 649 at 650; New Orleans *v.* Mangiarisina, 71 So. (La.) 886 at 890.

[78] Appeal of Blackstone, 190 Atl. (Del.) 597 at 602; Adamec *v.* Post, 7 N. E. (2d) (N. Y.) 120 at 121.

[79] Wiegardt *v.* Brennan, 73 Pac. (2d) (Wash.) 1330 at 1333; A. L. Roumfort Co. *v.* Delaney, 79 Atl. (Pa.) 653; Doncourt *v.* Danaher, 13 Atl. (2d) (Conn.) 868 at 871; Commonwealth *v.* S. S. Kresge Co., 166 N. E. (Mass.) 558 at 560–61; Spitler *v.* Town of Munster, 14 N. E. (2d) (Ind.) 579 at 581–2; Hutchins *v.* Department of Labor, 18 N. Y. Supp. (2d) 656 at 661.

[80] Taylor *v.* Village of Glencoe, 25 N. E. (2d) (Ill.) 62 at 65; Harmon *v.* City of Peoria, 27 N. E. (2d) (Ill.) 525 at 528; Nichols *v.* Park, 119 S. W. (2d) (Tex.) 1066 at 1068.

3. Good Faith of the Legislature

It will be presumed that the legislature acted in good faith in passing a law for the protection of the public health, safety and welfare, and this presumption extends to municipal ordinances.

If the constitutional limits of the exercise of the police power have not been transcended, that is, if there be any rational basis for its exercise in the particular case, the motive actuating the legislative body becomes immaterial and not a proper subject of inquiry, and the court will not substitute its opinion or judgment for that of the legislative body.[81]

4. Presumption re: Validity of Legislative Acts

There is a presumption, generally indulged in, to the effect that legislative acts in the exercise of the police power are validly adopted and will be validly exercised. On this subject one court has stated: "We must presume that the enforcing agencies will give the statute a reasonable and sensible construction both as to particular term and general purpose."[82]

This presumption is extended to municipal ordinances and the policy of the court is to uphold them, but the courts will not hesitate to "strike down" such legislation if it is, in fact, unreasonable.[83]

5. Reasonableness of Ordinances

An ordinance enacted to promote public health will be upheld as a valid exercise of the police power if its requirements are not unreasonable and if its provisions do not discriminate in favor of, or against, particular persons or classes of persons as to whom no reasonable basis of discrimination exists.[84]

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[81] Simpson *v.* City of Los Angeles, 4 Cal. (2d) 60; Masonic Cemetery Assn. *v.* Gamage, 38 Fed. (2d) (C. C. A. 9th) 950; 71 A. L. R. 1027; American Grocery Co. *v.* Board of Commissioners, 11 Atl. (2d) (N. J.) 599 at 601; Nulter *v.* State Road Commission, 193 S. E. (W. Va.) 549 at 550.

[82] National Fertilizer Assn. *v.* Bradley, 18 Fed. Supp. (D. C. So. Car.) 263 at 281.

[83] City of Chicago *v.* Clark, 194 N. E. (Ill.) 537 at 538; J. R. Watkins Co. *v.* Gann, 159 So. (La.) 747 at 748; Gilchrist Drug Co. *v.* City of Birmingham, 174 So. (Ala.) 609 at 614; Pacific Ry's Advertising Co. *v.* Oakland, 98 Cal. App. 165 at 167–68; City of Spokane *v.* Coon, 100 Pac. (2d) (Wash.) 36 at 38.

[84] In re Gatsios, 95 Cal. App. 762; People *v.* McGowan, 195 N. Y. Supp. 286 at 289; Cady *v.* City of Detroit, 286 N. W. (Mich.) 805 at 807; Lombardo *v.* City of Dallas, 73 S. W. (2d) (Tex.) 475 at 480–481.

6. Policy of Courts and Legislature to Safeguard the Public

The policy of the courts is to uphold police power legislation where the same is reasonably designed to protect the public health, welfare and safety; and the courts have recognized that this exercise of the police power is *an expanding right* developing to meet the new and different conditions which are constantly coming within the field of their operation.[85]

In the case of *In re Pedrosian*[86] the following opinion was voiced:

"Perhaps the lapse of time since the rendition of the decision of *Iler* v. *Ross*, *supra*, in 1902, would work a change in the opinion of that court. Certainly since then great strides have been made in the handling of all problems of public health and safety. No one would willingly go back to the days of the open toilet, the livery-stable, the hog-pen, or the alley overflowing with its filth, in the thickly populated portions of our cities. With modern methods being applied in all phases of community life, the people are not expected now to dull their sensibilities and endure the offenses which were formerly accepted as of necessity. If, as is stated, garbage is a nuisance *per se*, the same should be said of much of the rubbish accumulating in a city. One need not be a specialist to make an inspection. Little observation will reveal that much filth, withheld from the garbage pail out of regard for the well-being of hogs fed upon the contents, finds its way to the rubbish pile and the trash can. Considerations both of public health and safety suggest its prompt removal.

"Particular stress is laid upon the claim that unless rubbish is allowed to accumulate in large quantities it is not a danger to public health or safety. The evident purpose of the ordinance was to *prevent* its accumulation in large quantities. To our minds, the exercise of the police power in the timely prevention of a nuisance is preferable to its use for purposes of abatement after a nuisance has come into existence. That said power may be lawfully exercised for such purpose is well established."

The police power of a state is an indispensable prerogative of sovereignty and one that is not to be lightly limited; and even though, at times, its operation may seem harsh, the imperative necessity for its existence precludes any limitation upon its exercise save that it be not unreasonably and arbitrarily invoked and applied. Such power

[85] Jones *v.* City of Los Angeles, 211 Cal. 304 at 307.

[86] In re Pedrosian, 124 Cal. App. 692 at 696–697.

is not illimitable; and the marking and measuring of the extent of its exercise and application is determined by a consideration of the question of whether or not any invocation of that power, in any given case, and as applied to existing conditions, is reasonably necessary to promote the public health, safety, morals, or general welfare of the people of a community.[87]

A city, by ordinance, may forestall conditions injurious or detrimental to public health as well as abate them; and such conditions need not actually exist before the city may so act. This rule has been applied, among other instances, to the regulation of the sales of milk and cream to prevent typhoid epidemics and to the discharge of raw sewage into a surface stream to avoid pollution in general.[88] Thus, many courts have declared that the welfare of the people *is the supreme law of the land.*[89]

7. Wisdom of Statute

Although the power to invade property rights exists only to the extent to which its exercise is reasonably necessary to protect the health, safety or welfare of the people, the question whether or not such necessity exists is for the legislature to decide; and, if there is any basis in reason for its determination thereof, the decision is conclusive upon the courts.[90] The inquiry of the court is, and should be, only as to the power of the legislature and not as to the wisdom of the legislation;[91] nor is the court concerned with the "motives" of the legislature.[92] Whether the legislation is desirable or adequate, has been declared to be the concern only of the legislature.[93]

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[87] Miller *v.* Board of Public Works, 195 Cal. 477.

[88] Burns *v.* City of Enid, 217 Pac. (Okla.) 1038 at 1040; Dougan *v.* Board, 43 Pac. (2d) (Kans.) 223 at 227; Commonwealth *v.* E. E. Wilson Co., 135 N. E. (Mass.) 376; People *v.* Hamilton, 161 N. Y. Supp. 425 at 428–429; Town of Smithfield *v.* City of Raleigh, 178 S. E. (N. C.) 114 at 115–116; Pettis *v.* Alpha Alpha Chapter, etc., 213 N. W. (Nebr.) 835–838; State *v.* Newark Milk Co., 179 Atl. (N. J.) 116 at 124; City of Aurora *v.* Burns, 149 N. E. (Ill.) 784 at 787.

[89] City of Rochester *v.* Olcott, 16 N. Y. Supp. (2d) 256, 258; Earruso *v.* Board of Health, 200 Atl. (N. J.) 755, 758; Franklin *v.* State, 169 So. (Ala.) 295, 298; City of Shreveport *v.* Kansas City, etc., 190 So. (La.) 404, 407; Panhandle, etc. *v.* State Highway Comm. 79 L. Ed. (U. S.) 1090, 1097.

[90] Hornblower *v.* Masonic Cemetery Assn., 191 Cal. 83 at 91; In re Johnson, 40 Cal. App. 242 at 244.

[91] Helvering *v.* Davis, 81 L. Ed. (U. S.) 804; 109 A. L. R. 1319, 1326; People *v.* Dmytro, 273 N. W. 400 (Mich.); 111 A. L. R. 128, 131.

[92] Feldman *v.* City of Cincinnati, 20 Fed. Supp. (D. C. Ohio) 531, 534; Lisichin *v.* Andrews, 23 Fed. Supp. (D. C. N. Y.) 657, 659.

[93] Publix Cleaners *v.* Florida, etc., 32 Fed. Supp. (D. C. Fla.) 31 at 33–4; Williams *v.* Scudder, 131 N. E. (Ohio) 481 at 484.

C. Limitations on the Exercise of Police Power

As already noted, there are certain constitutional limitations upon the exercise of the police power with reference to health, sanitation and public welfare generally. If a law is unreasonable, its enforcement may deny the affected party the equal protection of the laws, may take his property without due process of law, or may impair the obligation of some contract to which he is a party. To avoid the applicability of these constitutional limitations, the act in question must not be arbitrary or unreasonable on its face; nor can it stand if its enforcement would result in an arbitrary or unreasonable limitation of, or an unwarranted infringement upon, the rights of certain groups or classes. On the other hand, the mere fact that the enforcement may prove burdensome or costly in a given instance is not, in and of itself, a sufficient reason for holding the act unconstitutional as a violation of the individual rights of a particular person or group of persons.

1. Constitutional Safeguards Available to the Public

When an ordinance interferes with the use or control of property without some rational relation to public safety, health, morals or general welfare, or when it is a palpable invasion of fundamental law, such enactment cannot be sustained as a legitimate exercise of the police power.[94] The state cannot impose regulations which do not bear a rational relation to the subjects which fall fairly within the police power or which use means which are within constitutional inhibitions. The means used *will* fall within those inhibitions whenever they are destructive, confiscatory, or so unreasonable as to be arbitrary.[95]

Where a measure is adopted to promote the public health or safety, it is concededly an exercise of the police powers of the state, but to justify the state in thus interposing its authority in behalf of the public, it must appear that the interests of the public generally, as distinguished from those of particular class, require such interference, and that the means are reasonably necessary for the accomplishment of the purpose, and not unduly oppressive upon individuals.[96] Laws or ordinances by which the rights of a citizen are subject to the unlimited discretion of an officer, without any rule or provision of law to govern or control his action, are unconstitutional; but laws or

[94] Appeal of White, 134 Atl. (Pa.) 409 at 413.
[95] State *v.* Heller, 196 Atl. (Conn.) 337.
[96] Coelho *v.* Truckell, 9 Cal. App. (2d) 47.

ordinances conferring authority or discretion as to the execution of the law, to be exercised under and in pursuance of the law, are not objectionable.[97]

To invoke the police power there must be some danger existent, or reasonably to be apprehended, which the exercise of the police power is to prevent; and the remedy proposed must be generally adapted to that purpose. The determination of the legislature in that regard is *not conclusive*.[98] Such police power cannot exceed the express or implied limitations of the Federal constitution.[99]

Every state has the power to pass and to enforce quarantine and health laws, to which individuals must submit for the good of the public; and the constitutional guaranties that no person shall be deprived of life, liberty, or property without due process of law, or denied the equal protection of the laws, do not limit the police power in respect to health any more than in any other connection.[100] It has been held that the mere grant by a city of a building permit for the construction of a hotel does not affect the right of the city, in the exercise of the police power, to adopt and apply to such hotel regulatory measures looking to the public health.[101]

When a remedial measure is undertaken under a valid law and fails to accomplish its purpose because of an unforeseen change in conditions or because of certain human errors in its administration, honestly committed, the enforcement thereof does not constitute a "taking of property without due process of law."[102]

Finally, it must be noted that no member of the public has a vested right in the continuation of a "menace" to public health and safety.[103]

2. Retroactive Operation of Health Statutes

It was held in the case of *London* v. *Robinson*,[104] as follows:

"Turning to the amending Ordinance No. 6708 (N.S.), it will be found that it is wholly silent regarding its provisions having any retroactive effect. . . . As stated above, it took effect August 7, 1925.

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[97] City of Evanston *v.* Wazau, 4 N. E. (2d) (Ill.) 78; 106 A. L. R. 789.

[98] People *v.* Caponigri, 6 N. Y. Supp. (2d) 577 at 582; State *v.* Danberg, 6 Atl. (2d) (Del.) 596 at 599-600.

[99] Jorden *v.* Gaines, 8 Atl. (2d) (Me.) 585 at 587.

[100] People *v.* Robertson, 134 N. E. (Ill.) 815; French *v.* Davidson, 143 Cal. 658 at 662.

[101] Daniels *v.* City of Portland, 265 Pac. (Ore.) at 792.

[102] Smith *v.* Witherow, 102 Fed. (2d) (C. C. A. 3rd) 638 at 642; Graham *v.* Kingwell, 218 Cal. 658 at 660.

[103] People *v.* McCloskey, 76 Cal. App. 227 at 230.

[104] 94 Cal. App. 774 at 776-777.

Under well-established rules it spoke only from that date. In 43 C.J. 574, the general rule is stated as follows: 'As is the case with statutes, ordinances or by-laws operate in the future only, and are never to be given a retroactive effect if susceptible of any other construction. An intention that a statute or an ordinance shall have a retroactive operation is not to be presumed, but must be manifested by clear and unequivocal language, and in case of doubt, the statute or ordinance must be construed to have a prospective effect only.' "

It has been held that municipal ordinances establishing fire limits cannot be made retroactive so as to require the removal of existing buildings or prohibit the use thereof, but that the municipality can, from time to time, compel minor changes in old buildings and make certain regulations in regard thereto, provided such regulations do not require the destruction of the buildings or discontinuance of their use; provided, however, that destruction may be accomplished if the building is, in fact, a nuisance.[105] The fact, however, that a building was erected in accordance with the requirements of the building code, in force at the time, gives the owner no vested right to immunity from subsequent reasonable regulations passed in the interest of the public safety.[106] In addition, the city has the right, in the exercise of the police power, to enact an ordinance retroactive in effect to compel a building owner to make necessary changes to reduce the fire hazard of a building erected prior to the passage of the ordinance.[107]

There is no constitutional inhibition against the passage of retroactive ordinances where the attack is based upon that ground alone.[108] And if actual injury is likely to result from some act, such as the discharge of contaminating matter into a surface stream, the exercise of such privilege may be curtailed or completely prohibited.[109]

3. Operation of Health Statutes Extraterritorially

From the authorities, it would appear to be competent for the legislature to extend the power of the municipal health authorities over adjacent territory; and the courts will, if possible, sustain such

[105] Hill Military Academy *v.* City of Portland, 53 Pac. (2) (Ore.) 55 at 60.
[106] 12 C. J. Constitutional Law 967, §530.
[107] Coffin *v.* Blackwell, 199 Pac. (Wash.) 239 at 241–242; Biscay *v.* City of Burlingame, 127 Cal. App. 213, 220; Forbes *v.* Mayor etc. of City of Wilmington, 40 Atl. (Del.) 1105, 1106.
[108] Patek *v.* California Cotton Mills, 4 Cal. App. (2) 12 at 15.
[109] State *v.* Griffin, 39 Atl. 260 at 261 (N. H.).

power in a local board where it is essential to the protection of the health of the community. But local boards are usually confined in their action to their territorial limits; and where action outside thereof is necessary, it must be taken by the state board, if one exists with power to act. A delegation of health power to a municipality does not preclude the state from exercising such powers itself within the limits of the municipality.[110]

Municipalities may exercise extraterritorial powers when the possession and exercise of such powers are essential to the proper conduct of the affairs of the municipality.[111] In the case of *Bellows* v. *Raynor*[112] the following statement formed part of the opinion of the court:

". . . Of the food supplies introduced into the city of New York, milk is one of the most important. It is now a matter of common knowledge that, if infected, it carries with it the germs, or bacilli, of dangerous and epidemic diseases. It is the food of the infant, and it is an important element of the food of an adult. It may be infected as it comes from the cow, or it may be contaminated by reason of the insanitary conditions of the dairy. Whatever, therefore, the department of health may do towards preventing the introduction of milk into the city of New York, which its officers have reason to believe to be unwholesome and deleterious, it is in the performance of a statutory duty. It is unreasonable to say that the department of health, in exercising such a power, renders itself amenable to the charge of exercising an extraterritorial jurisdiction. In notifying the creamery company not to include the plaintiff's milk in its shipments to the city, it was acting for the protection of the inhabitants of the city of New York, and therefore for local interests. There was no interference with the plaintiff's conduct of his farm or business, except as he proposed to supply milk to the city of New York; there was simply an embargo laid upon the introduction, within the city of New York, of any milk not produced by him under conditions specified by the department. It had the right to exact from all shippers of milk a compliance with such conditions as would reasonably tend to a pure product for the use of the citizens as a condition of permitting its sale in the city of New York. In exercising the supervision and in taking the preventive measures, which appear in

[110] 25 Am. Jur. Health 295, §15.

[111] In re Bolis, 179 Cal. 291 at 296–7.

[112] Bellows *v.* Raynor, 101 N. E. (N. Y.) 181 at 183–4; Ex parte Boyle, 123 S. E. (S. C.) 9 at 10.

the evidence, the department of health was properly and reasonably executing the duty imposed upon it by the statute of conserving the public health, in which, as I have already observed, the state at large is equally interested with the city."

4. That Compliance With a Health Statute May Result in Expense Is No Excuse for a Failure to Comply Therewith

Health regulations are of the utmost consequence to the general welfare; and if they are reasonable, impartial, and not against the general policy of the state, they must be submitted to by individuals for the good of the public, irrespective of individual pecuniary loss.[113]

So far as the Federal Constitution is concerned, a state may, by itself or through authorized municipalities, declare the emission of dense smoke in cities or populous neighborhoods to be a nuisance and subject to restraint as such; and the harshness of such legislation and its effect upon business interests, short of a merely arbitrary enactment, are not valid constitutional objections; nor is there any valid Federal constitutional objection in the fact that the regulation may require the discontinuance of the use of property, or subject the occupant to large expenses in complying with the terms of the law or ordinance.[114] An unusual expense or cost of compliance, however, may be an element which the court will consider in determining the validity of the statute in question;[115] although it is the general rule that a state and/or its board of health may abate nuisances at the expense of persons maintaining such nuisances.[116]

5. Individual Rights

The mere fact that some individual rights are more directly affected than others does not prevent the courts from upholding the validity of the health statute.[117]

D. Regulation of "Nuisances" Generally

There were, and are, a number of "nuisances," such as excessive or pungent smoke, "fire traps," actual pollution of water supplies and filth collecting and disease breeding fixtures of various types, which are recognized at the common law.

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[113] 25 Am. Jur. Health 299, §21.

[114] Northwestern Laundry *v.* Des Moines, 60 L. Ed. (U. S.) 396 at 397; Jordan *v.* Smith, 242 N. Y. Supp. 142 at 147.

[115] Mo. Pac. Ry. Co. *v.* Norwood, 13 Fed. Supp. (D. C. Ark.) 24; Haag *v.* City of Mt. Vernon, 58 N. Y. S. 581, 584.

[116] City *v.* Laabs, 177 N. W. (Wisc.) 916–917.

[117] People *v.* Ryan, 243 N. Y. Supp. 644 at 649; 25 Am. Jur. Health 304, §26.

In addition to these common law "nuisances," legislatures and administrative bodies have classified other unhealthful and dangerous conditions as "nuisances," and, in most instances, such classification has been upheld under the aforementioned "police power." Any and all such declarations are, however, subject to the general rule that a given condition or a particular piece of equipment or other property is not a "nuisance" merely because some legislative body or administrative officer has so declared, and that, in the final analysis, it is the province of the court to determine whether the facts, in a given instance, justify the conclusion that a "nuisance" *does* exist.

With respect to the abatement of nuisances generally, it has been stated that matters or things constituting such nuisances are obviously within the purview of the police power; and the abatement of such nuisances is one of the chief powers conferred upon health authorities, either by the legislature of a state or by the council of the municipal corporation. Where express power is given to municipalities to abate nuisances and to establish boards of health with such power as is necessary to protect the community from diseases, there can be no doubt that boards of health may be invested with power to abate nuisances dangerous to health. Even where such authority is not expressly conferred upon a municipality, it has implied power to pass reasonable ordinances relative to such matters. Moreover, since such powers are an essential part of municipal government, their delegation to boards of health would seem to be as proper where they are merely implied as where they are expressly conferred upon the municipality.[117]

It has also been stated, however, that a finding by the health authorities that a nuisance exists in any particular case *is not conclusive* upon the courts, and that the latter may review the action of such authorities and may judicially determine the question of the existence of a nuisance. The form of expression usually adopted by the courts is to the effect that "the power to prevent and abate nuisances does not authorize the extrajudicial condemnation and destruction, as a nuisance, of that which, in its nature, situation, or use, is not such." It has also been declared that the finding of a sanitary committee, of a municipal council, or of any other body of a similar kind, can have no effect whatever, for any purpose, upon the ultimate disposition of a matter of this kind, and that it cannot be used as evidence in any legal proceeding, for the end of establishing, finally, the fact of nuisance. If such a finding can be made "testi-

mony" for any purpose, it would be such only to show that the persons acting in pursuance of such finding were devoid of that malicious spirit which sometimes aggravates a trespass and swells the damages; that the question of nuisance can be decided, for all legal uses, only by an established court of law or equity; and that the resolutions of officers, or of boards organized by force of municipal charters, cannot, to any degree, control such decision. The declaration by such officer or board of the existence of a nuisance, however, is considered, for the same reasons which give presumptive legality to the acts of other official persons, *prima facie* evidence of the fact until such finding is questioned or assailed.[118]

1. Regulation of Nuisances Generally

In the exercise of the police power, the legislature may decree to be a "nuisance" that which was not one *per se* at common law.[119]

In the case of *Maguire* v. *Reardon*[120] it was held that a temporary wooden building, erected in violation of law within the fire limits of the City and County of San Francisco, after the great conflagration of April 18, 1906, constituted a public nuisance, and that the court (sitting in equity) refused any relief designed to perpetuate the maintenance of such nuisance, regardless of the validity of the ordinance under which the board of public works proceeded to demolish the building. The building, sought to be removed by the city, having been erected after the passage of the ordinance defining the fire limits, it was held that an ordinance providing for the demolition and removal of wooden buildings, in general, within such limits did not apply retroactively to said building. As to a building constructed after the passage of such ordinance, however, the court stated that, if a building is erected in violation of an ordinance fixing the fire limits, it may be torn down and removed without any judicial proceeding whatever, and that the fact that the city permitted the erection of such a building in violation of the ordinance did not constitute an implied contract upon the part of the city that the owners of the building should be permitted to maintain it perpetually, and, in addition, contract with others for the use and enjoyment thereof. It was further held that the police power could not be bartered away,

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[118] 25 Am. Jur. Health 316-317, §39.

[119] Heerdt *v.* City of Portland, 8 Fed. (2d) 871 (D. C. Ore.) 871-2; Upton *v.* Felton, 4 Fed. Supp. (D. C. Nebr.) 585, 587; People *v.* N. Y. Edison Co., 144 N. Y. Supp. 707, 710; M. L. Weiss, Inc. *v.* Whalen, 238 N. Y. Supp. 95, 101.

[120] Maguire *v.* Reardon, 41 Cal. App. 596.

even by express contract, and that the power to remove a wooden building erected within the fire limits is an exercise of the police power of the first importance.

The legislature may declare that to be a nuisance which is such in fact; and if an act or thing is done or maintained in violation of law it may constitute a nuisance. Nuisances may be public, or private, or both, the distinction lying not in the number of persons affected by it, but in the special injury which results to a particular individual by reason of the injurious conduct or condition.[121] It has been held that anything which annoys, injures or endangers the comfort, repose, health or safety of others, is a nuisance.[122]

To justify a summary proceeding under the police powers of a city for the abatement of a nuisance, consisting of dilapidated buildings, it must appear that considerations of public safety with respect to property, and/or public health or morals are actually involved, and that the buildings constituted a nuisance in fact. In connection with such summary abatement of public nuisances, however, the ordinance need not require notice to the owner or give him the right to a hearing and an opportunity to be heard,[123] since the public health might suffer or be imperiled if their action could be delayed until a protracted hearing could be brought to a termination.[124] A city cannot, however, without express statutory authority, declare a dilapidated building within its limits to be a nuisance if it is not so in fact.[125]

It is not an unreasonable exercise of police power by a city to require an abutting landowner to connect his buildings with a public sewer, notwithstanding he may already have a private sewer. The object of such a health code is the sanitary condition of dwellings, the prevention of disease, and the maintenance of public health; and this may be done by the prevention of nuisances as well as by their abatement. Since anything injurious to public health may be a nuisance, it is as much the duty of a board of health to prevent a condition likely to be detrimental to public health, as to abate it after its evil consequences appear.[126]

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[121] Biber *v.* O'Brien, 138 Cal. App. 353.

[122] Ex parte Jones, 109 Pac. (Okla.) 570 at 575.

[123] Porter *v.* City of Lewiston, 238 Pac. (Ida.) 1014.

[124] 25 Am. Jur. Health 315, §38.

[125] Crossman *v.* Galveston, 247 S. W. (Tex.) 810; 26 A. L. R. 1210 at 1213.

[126] Fenton *v.* Atlantic City, 103 Atl. (N. J.) 695.

Where a thing may or may not be a nuisance, depending on a variety of circumstances requiring judgment and discretion on the part of municipal authorities in exercising their legislative functions under a general delegation of power, their action is conclusive; but that which is not in and of itself (by its nature or character or the manner of its use or disposition) a nuisance cannot be made so by the mere fiat of municipal authorities; and the action of a city is then subject to judicial review as to the reasonableness of the regulation adopted.[127]

A municipal ordinance prohibiting the installation, in any building thereafter erected, of certain kinds of water closets, and providing that such closets, when found to be a nuisance, should be removed, is not invalid for indefiniteness either because of the failure to define the physical conditions which should constitute a nuisance, or to state who should find the closets to be a nuisance or who should remove them, as it is not necessary to define the physical conditions which should constitute a nuisance. The words "found to be a nuisance" do not require a judicial or official finding, but mean "found, discovered, or perceived" to be a nuisance by anyone affected by the nuisance. The person, who should remove the closet, is necessarily the person who allowed it in the building and had authority to remove it.

Whatever is offensive physically to the senses, and by such offensiveness makes life uncomfortable is a "nuisance"; and the existence of such offensive condition is essential to the recovery of a fine imposed by an ordinance for violations of the provisions thereof. The burden of proving the existence of a condition offensive physically to the senses, and thereby making life uncomfortable, rests upon the enforcing body.

Although the occupant, and not the owner, is ordinarily responsible for injuries arising from a failure to keep premises in repair, if such premises are let with a nuisance on them, the landlord is liable for an injury caused by such nuisance; and, under a city ordinance requiring the removal of water closets, when "found to be nuisances," an owner is not entitled to notice to remove such a closet, but is bound to do so if, and when, it becomes such a nuisance.[128]

The fundamental and commonly recognized attributes of a "public nuisance" are the same whether at common law or by statutory

[127] Smith *v.* City of New Albany, 93 N. E. (Ind.) 73.
[128] City of Chicago *v.* Atwood, 110 N. E. (Ill.) 127.

regulation, "public nuisances" being founded on wrongs that arise from unreasonable, unwarrantable or unlawful conduct working an obstruction or injury, and producing material annoyance, inconvenience and discomfort, to the public.[129] That the judges of lower courts, as well as those of appellate courts, recognize the necessity of the growth of health restrictions, to correspond with that of cities, is illustrated by the following paragraph from the *Willis* case (*supra*):[130]

"I might add the following observations, prompted by a keen sense of civic pride. From the physical conditions present now, it would appear that the complete filling in of the remaining portion of the ditch has become a necessity, since the excavation is partly filled with refuse, besides stagnant and putrescent water. It is my considered opinion, frankly here expressed, that rather than impede this owner in developing his land, the municipal authorities should encourage a prompt disposition of the matter by lending him a helping hand, and suggestions on how to cope with the obvious need of building some sort of sub-surface retaining wall or culvert to prevent dirt and fill from clogging the pipe under the line of the sidewalk, so that the flow of what will be sub-surface water may continue. This property, located as it is upon the World's Fair Boulevard, close to Queens Boulevard, two of the main thoroughfares of Queens Borough, has undoubtedly become quite valuable, craving for improvement. Years ago, in a different age, and its 'horse and buggy days,' beloved to some of us surviving, and bringing back tender memories of childhood vagaries, that section of Queens Borough involved in this controversy was sparsely settled, and as far back as 'the mind of man runneth not to the contrary,' was the westerly limit of the then infamous Flushing swamp with its prolific mosquitoes of every size and species, preying upon the helpless inhabitants of adjacent communities. The march of time, the living organism of human progress, the growth of the City and of the Borough have worked havoc with all that. What were the endless and dreaded swamps have been transformed by the magic of human genius into the World's Exposition Grounds, the most beautiful and instructive assemblage of products of human endeavor ever gathered together for astonished eyes to enjoy. But a short distance from this lowly ditch,

[129] People *v.* Willis, 17 N. Y. Supp. (2d) 784 at 785.
[130] Ibid., at pp. 789, 790.

multitudes of peoples from near and distant lands congregate and admire the manifold panorama of science, art, skill, industry and human ingenuity. Progress is depicted and dramatized at every hand. Little do our welcome visitors know, or care, of the turmoil this antiquated ditch is causing and of its insignificant place in contemporary local history. The City Fathers charged with the duty dictated by the rapid strides of civilization should exert all efforts to beautify every corner of our great Borough and make it the cynosure of all eyes. The elimination of this obscure but odious ditch, as a salutary step towards the removal of eyesores wherever possible, would undoubtedly be welcomed and acclaimed."

The regulatory statute need not, however, cover remote contingencies or extreme cases.[131]

The legislature may not make an arbitrary declaration of what constitutes a nuisance and that which is not a nuisance in fact cannot be made so by legislative fiat.[132] Unless a nuisance is widely recognized as a "common law nuisance" it is a judicial question as to whether said condition is, in fact, a nuisance.[133]

No person or corporation acquires a vested right, by lapse of time, to the maintenance of that which is a nuisance in fact.[134] If a nuisance in fact exists, the proper public officers may remove the same at the expense of the owner or may destroy the property constituting such nuisance.[135]

The order of a public official with reference to an alleged nuisance is *prima facie* proof of the existence thereof, thus shifting the "burden of going forward" to the person maintaining such alleged nuisance.[136] Ordinarily, however, before public officials may take active steps to abate a nuisance, reasonable notice must be given to the owner so that he may have an opportunity to accomplish the same result.[137]

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[131] In re Mathews, 191 Cal. 35 at 38, 44.

[132] Globe School Dist. *v.* Board of Health, 179 Pac. (Ariz.) 55, 57; Ray *v.* City of Belton, 162 S. W. (Tex.) 1015, 1017.

[133] Rowland *v.* Florida, 176 So. (Fla.) 545; 114 A. L. R. 443, 445; Westchester Elec. Ry. Co. *v.* Angevine, 65 N. Y. Supp. 376, 378.

[134] White *v.* Sun Cook Mills, 13 Atl. (2d) (N. H.) 729 at 732.

[135] Durgin *v.* Minot, 89 N. E. (Mass.) 144, 146; Cartwright *v.* Board of Health, 56 N. Y. Supp. 731, 733.

[136] State Fire Marshal *v.* Sherman, 277 N. W. 249, 250; Golden *v.* Health Dept., 47 N. Y. Supp. 623, 626.

[137] Morison *v.* Rawlinson, 7 S. E. (2d) (S. C.) 635, 639; Eckhardt *v.* City of Buffalo, 46 N. Y. Supp. 204, 213.

2. The Right of the Administrative Body, in the Exercise of the Police Power, to Destroy Property or Require Additions Thereto

An ordinance providing that rooms in dwellings, erected prior to the passage of the ordinance, should thereafter be provided with windows meeting the requirements specified by the ordinance has been held "not retrospective."[138] It has been held also that the demolition and removal of a wooden building which the state courts find to have been erected in a municipality, within the fire limits theretofore prescribed, contrary to valid local regulations duly enacted under the municipal charter, may be ordered by the municipality without violation of the Federal Constitution.[139]

When the public interest is involved, the preferment of that interest over the property interest of the individual, to the extent even of the destruction of property, is one of the distinguishing characteristics of every exercise of the police power which affects property.[140] A statute requiring the owner of property to install and maintain hall and stairway lights in apartment houses and the regulations of the district commissioner, adopted pursuant thereto, have been held applicable to buildings erected prior to the passage of such act.[141]

The state (or a municipality to which the police power has been delegated) in the exercise of its police power, in an emergency requiring prompt action for the public good, may take or destroy private property in a summary manner.[142] The legislature may, in its discretion and within reasonable limits, require that buildings conform to such minimum standards as are essential for safe, decent, and sanitary dwelling places, notwithstanding previous toleration of evils later sought to be remedied, where such dwellings are unsafe or unsanitary or fail to provide the amenities essential to decent living.[143] It has been held, however, that the owner of a building, erected within territory subsequently included within the fire limits, acquires a vested property right therein of which he cannot be deprived without some lawful reason.[144] It was further held[145] that the proper test, as a basis for action by the authorities in protecting pedestrians from

[138] Daniels *v.* City of Portland, 265 Pac. 790 at 792 (Ore.).
[139] Maguire *v.* Reardon, 65 L. Ed. (U. S.) 625.
[140] Miller *v.* Schoene, 72 L. Ed. 568 at 571.
[141] Hill *v.* Raymond, 81 Fed. (2d) (C. C. A. Dist. of Col.) 278 at 279.
[142] Vanderhoven *v.* City of Rahway, 1 Atl. (2d) (N. J.) 303 at 304.
[143] Adamec *v.* Post, 7 N. E. (2d) (N. Y.) 120.
[144] Russell *v.* City of Fargo, 148 N. W. (N. D.) 610 at 614, 615.
[145] Ibid. at 615.

falling walls or similar dangers, is not the percentage of deterioration of a building, but rather the ability, or willingness, of the owner to make the structure safe.

The court cannot substitute its judgement for that of the city council with regard to the necessity, in a given case, of legislation, if the facts, as shown, tend to support the decision of said council.[146]

If, during construction of a building, a dangerous condition is found to exist, actually or potentially, a permit for such construction may be revoked under the police power.[147]

The word "nuisance" need not be used in a statute in order that it may be applicable to "nuisances."[148] In every instance where a premises is held to be a nuisance, the owner thereof should be allowed to repair it if the making of such repairs is feasible.[149]

3. Action by Administrative Officers to Abate Nuisances, etc.

Administrative officers, charged with the duty of enforcing the health laws, have an action to abate nuisances, and may, by an injunction, prevent the pollution of the domestic water supply.[150]

E. Enforcement of Administrative Rules and Regulations

It is a well recognized principle of "administrative law" that a legislative body may promulgate general provisions designed to effect the removal, or control, of a given evil, and, provided these basic principles are sufficiently well stated in the legislative act, may delegate to an administrative body or official a certain amount of discretionary, as well as ministerial, power with respect to the enforcement of such provisions. Not only must the administrative officer confine his activities to, and within, the scope of the provisions of such a legislative act, but, in administering those provisions, he must act, at all times, in a reasonable manner; and he may not enforce them arbitrarily or without regard to the circumstances of a particular case.

The power granted to administrative boards (of the nature of

[146] Horbach *v.* Butler, 281 N. W. (Nebr.) 804 at 805.

[147] Geneva Investment Co. *v.* St. Louis, Mo., 87 Fed. (2d) (C. C. A. 8th) 83 at 89.

[148] York *v.* Hargadine, 171 N. W. (Minn.) 773 at 774.

[149] State Fire Marshal *v.* Fitzpatrick, 183 N. W. (Minn.) 141 at 142.

[150] Mayor of Cambridge *v.* Dean, 14 N. E. (2d) (Mass.) 163 at 165; Newton *v.* City of Groesbeck, 299 S. W. (Tex.) 518 at 519; City of Seattle *v.* Seibert, 225 Pac. (Wash.) 67; Board of Health *v.* Copcutt, 35 N. E. (N. Y.) 443; Sings *v.* City of Joliet, 86 N. E. (Ill.) 663; Commonwealth *v.* Soboleski, 153 Atl. (Pa.) 898.

boards of health) to adopt rules, by-laws, and regulations, reasonably adapted to carry out the purpose or object for which they are created, is generally held not to be a delegation of legislative authority in violation of the usual constitutional prohibition. For the protection of the health of the community, the most extensive powers may be conferred on such boards, whether state or local. Whatever doubt there may be as to the extent of powers not expressly conferred, there can be no question that the legislature may invest them with the most ample authority within the locality in which they are to act. Such a delegation of power generally comes within the rule which provides that, although it is necessary that a law, when it comes from the law-making power, be complete, there are many matters relating to methods or details which may be, by the legislature, referred to some designated ministerial officer or body, and that all such matters fall within the domain of the right of the legislature to authorize an administrative board or body to adopt ordinances, rules, by-laws, and regulations in aid of the successful execution of some general statutory provision.[151]

1. Enforcement of State Rules and Regulations re: Health

It is mandatory that cities enforce, or require the enforcement of, state health rules and regulations, and, in that connection, that the cities, within their boundaries, perform general duties and obligations with respect to the maintenance and preservation of the public health.[152]

2. Enforcement of Rules and Regulations Generally

A municipal corporation, a county, or a township may, in certain instances, by direct action on its part, invoke an appropriate civil remedy to coerce obedience to its ordinances or regulations, adopted in the exercise of its police power as granted to it by a state constitution. Where the personal welfare and the property rights of a large number of the inhabitants of a city or town would be detrimentally affected by a violation of a police or sanitary regulation, whether the ordinance provides other means for its enforcement or not, such city or town may, by means of the writ of injunction, appeal to a court of equity, to restrain such violation or to cause the wrongful effect to be

[151] 25 Am. Jur. Health 289, §5.

[152] State *v.* City of Van Wert, 184 N. E. (Ohio) 12, 15; Pierce *v.* Doolittle, 106 N. W. (Iowa) 751; Hess *v.* City of Canton, 189 N. E. (Ohio) 18, 20.

removed.[153] Such injunctive relief (as well as a resort to any penalties which may be provided by the specific statute or code) is available for the enforcement of municipal rules and regulations.[154]

3. Delegation of the Police Power by the State to Municipalities and Other Public Bodies

The state, in the exercise of its police power to enact health regulations, may use such agencies, including municipalities, counties or other territorial subdivisions, as it pleases to accomplish its purposes in that regard.[155] Although legislative delegation of the power to exercise discretion as to what the law shall be is forbidden, this rule does not apply to a delegation of the use of discretion in the administration of a specific law.[156]

In California it has been held that the provisions of the plumbing code of a freeholders' charter city are not applicable to work done by a state civil service employee on state-owned property located within the territorial boundaries of a city.[157] Under most constitutions, cities having freeholders' charters have a wide discretion in the exercise, within their limits, of the police power with reference to health.[158] Under the "municipal affairs doctrine," the supervision of the health, safety and welfare of the inhabitants of a city is chiefly a municipal concern.[159]

As illustrative of the exercise, by counties, within their borders, of the police powers of the state, attention is called to the case of *Stanislaus etc.* v. *Stanislaus.*[160]

4. Propriety of the Delegation of Certain Features of the Police Power to Administrative Officers

A municipal ordinance is not invalid because it delegates to a board of health the authority to determine when the rule as to vaccinations shall be enforced, although the ordinance does not provide any rule

[153] City of Stockton *v.* Frisbie and Latta, 93 Cal. App. 277 at 278; Inhabitants of Swansea *v.* Pino, 164 N. E. (Mass.) 390, 391; State *v.* Kirby, 94 N. W. (Iowa) 254.

[154] State *v.* Compere, 103 Pac. (2d) (N. M.) 273 at 276 277.

[155] Lausen *v.* Board of Supervisors, 214 N. W. (Iowa) 682 at 684.

[156] Spahn *v.* Stewart, 103 S. W. (2d) (Ky.) 651 at 660.

[157] In re Means, 31 Cal. App. (2d) 290.

[158] Feldman *v.* City of Cincinnati, 20 Fed. Supp. (D. C. Ohio) 531, 536; Pasadena School Dist. *v.* Pasadena, 166 Cal. 7; People *v.* Valarde, 45 Cal. App. 520, 524; City of Dallas *v.* Smith, 107 S. W. (2d) (Tex.) 872, 875.

[159] People *v.* Williamson, 135 Cal. 415.

[160] 8 Cal. (2d) 378 at 383-384.

for the guidance of the board.[161] The state may delegate to administrative officers, or boards, the power to determine the facts, matters and things which, under the statute, sustain their actions.[162] It has been held, however, that it is the function of the legislature to determine what standards of safety should be required; and it has further been held that the legislature may not delegate such authority to an administrative officer nor intrust, to an administrative officer, plenary discretion to determine how, when, and where the safety, welfare, and health of the public should receive protection from dangers such as those which might be created by improperly planned multiple dwellings or lodge houses.[163]

5. The Power of Administrative Officers, Generally, to Make Rules and Regulations

Within reasonable bounds, the legislature may confer regulatory powers upon the state board of health and may give to that board authority to adopt rules and regulations having the force and effect of law.[164] Municipalities may adopt rules and regulations in addition to those promulgated by the state board of health,[165] and may prescribe penalties, insofar as they are applicable within the cities' own territorial boundaries, other than, and different from, those prescribed by the state.[166] The city council, in passing a police power ordinance, cannot, however, ignore the provisions of the general statutes covering the same ground.[167]

6. The Requirement That Health Rules and Regulations Must Be "Reasonable"

With respect to the Department of Water and Power of Los Angeles, it has been held that, under the city charter, it has the right and the power to prescribe reasonable rules and regulations covering the service of water to consumers (including the extension of mains) and to refuse service in those cases in which a consumer refuses to

[161] Zucht *v.* King, 67 L. Ed. (U. S.) 194 at 198.

[162] Southern Railway Co. *v.* Commonwealth, 167 S. E. (Va.) 578 at 581; Boshwizen *v.* Thompson & Taylor Co., 195 N. E. (Ill.) 625 at 629.

[163] Lyons *v.* Prince, 24 N. E. (2d) 466 (N. Y.).

[164] Shilkett *v.* State, 232 Pac. (Okla.) 127; Egan *v.* City of Miami, 178 So. (Fla.) 132; State *v.* Morse, 80 Atl. (Vt.) 189.

[165] LaCrosse, etc. *v.* City of La Crosse, 285 N. W. (Wis.) 393, 401-402; S. H. Kress & Co. *v.* Dept. of Health, 27 N. E. (2d) (N. Y.) 431-432.

[166] Shaw *v.* City of Norfolk, 189 S. E. (Va.) 335 at 338.

[167] Murphy *v.* Wright, 115 S. W. (2d) (Tex.) 448 at 451.

comply with such rules and regulations. It has further been held that such a refusal of service will be upheld if there is no showing of bad faith or fraudulent conduct on the part of the Department in respect of the terms imposed by such rules and regulations and if it is not shown that the exercise of its discretion in that regard is not in good faith.[168]

Health officers of a city should be clothed with sufficient authority to enable them to deal with conditions affecting the public health and to meet emergencies in a prompt and effective manner; and, in the execution of measures enacted to that end, they will be upheld in the exercise of a wide discretion. But where the municipal authority has neglected to provide suitable rules and regulations upon the subject, and the executive officers are left to adopt such measures as they deem suitable for the occasion, their acts are open to judicial review; and, to be sustainable, their measures must respect the constitutional rights of individuals, be uniform in their operation, and be reasonably adapted to secure the object in view.[169] Regulations made by a state board of health, under legislative authority, may be reviewed by the courts only upon the question of their reasonableness; and if a responsible, honest and presumably reasonable body of professional opinion is found in support of the regulation it must be upheld.[170] A public health law requiring every local board of health to make such regulations as they may deem necessary for the preservation of life and health, and for the execution and enforcement of said law in the municipality, does not, however, give such boards authority to delegate power to an agent in cases where the exercise of judgment and discretion is required.[171]

The courts grant municipalities and water companies a wide latitude in the adoption of health rules and regulations[172]; and it has been held that such rules and regulations have the force of legislative

[168] Sminia *v.* Department of Water and Power of the City of Los Angeles, 119 Cal. App. 428.

[169] Wong Wai *v.* Williamson, 103 Fed. (C. C. Calif.) 1.

[170] Community Chautauquas *v.* Caverly, 244 Fed. (D. C. Vt.) 893 at 894.

[171] City of Hudson *v.* Flemming, 123 N. Y. Supp. 1065, at 1066; Standard Oil Co. of New York *v.* Board of Purification, 111 Atl. (R. I.) 887 at 889; Sprague *v.* Dorr, 69 N. E. (Mass.) 344; Rock *v.* Carney, 185 N. W. (Mich.) 798 at 799.

[172] Shiras *v.* Ewing, 29 Pac. (Kan.) 320; State *v.* Everett Water Co., 80 Pac. (Wash.) 794; Thomas *v.* Peterson, 24 S. W. (Tex.) 1125; Harbison *v.* Knoxville Water Co., 53 S. W. (Tenn.) 993; City of Hazard *v.* Minge, 92 S. W. (2d) (Ky.) 768 at 769; Poole *v.* Paris Mountain Water Co., 62 S. E. (S. C.) 874 at 875.

enactment.[173] On the other hand, it has also been held that such rules and regulations have only the force of "by-laws" similar to those adopted by privately owned water companies.[174]

In any event, a municipality may not prescribe a particular mode of abating a nuisance if the owner in fact uses another, and equally satisfactory, method.[175]

7. Conflict Between Administrative Departments

It has been held that, in an action by one city department to abate a nuisance, such as a dilapidated building being used for a stable, the fact that, for a long time prior to the commencement of the action, the owner had endeavored to obtain a permit from another city department to maintain and operate said stable but had been unsuccessful because of numerous delays, refusals and neglects of the municipal officers, did not constitute a bar to the action.[176]

Likewise, it has been held that where a building code lodged in the superintendent of buildings exclusive jurisdiction to regulate the number and forms of fire escapes in hotels, the fire commissioner (whose jurisdiction was not made concurrent with that of such superintendent of buildings in such respect by provisions of the New York City Charter empowering him to enforce what the superintendent has prescribed) was without authority to change the method of construction—the power to regulate being in one, and the power to execute being in both.[177] It has, however, also been held: (1) that the fact that a building code provided for the installation of perforated pipes in buildings of a certain character, and conferred certain powers upon the building department in reference to them, was not inconsistent with the exercise of jurisdiction over the same subject matter by the fire commissioners; (2) that the owners of a building cannot escape liability for failure to comply with an order of such fire commissioners to install a system of perforated pipes because their tenant was in possession of the premises at the time the order was made; and (3) that, by the terms of the lease he was required to comply with all laws, orders, and regulations of the state and municipal authorities, since they, as landlords, had the right to enter upon the premises to comply with an order of the fire commissioner.[178]

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[173] Kirk *v.* Wyman, 65 S. E. (So. Car.) 387 at 389-90.
[174] Etheredge *v.* City of Norfolk, 139 S. E. (Va.) 508 at 510.
[175] Purnell *v.* Maysville Water Co., 234 S. W. (Ky.) 967 at 969.
[176] People *v.* Ryan, 17 Cal. App. (2d) 1.
[177] U. S. Trust Co. *v.* Blake, 137 N. E. (N. Y.) 327.
[178] Lantry *v.* Hoffman, 105 N. Y. Supp. 353.

8. Validity of Administrative Acts in the Administration of Public Health

It has been held that an act to protect public health by preventing dissemination of dangerous communicable diseases, through isolation and quarantine measures, which discloses the non-observance there of a misdemeanor, is not unconstitutional, on the ground that the act delegates legislative power, because it confers on the state board of health authority to designate such diseases as are infectious, contagious, or communicable in their nature, and to prescribe proper control measures therefor.[179] A legislature cannot delegate its power to make a law, but it can make a law delegating the power and authority to determine some fact or state of things upon which the law makes, or intends to make, its own action depend. "To deny this would be to stop the wheels of government." There are many things upon which wise and useful legislation must depend, which cannot be known to the law-making power, and must therefore be a subject of inquiry and determination outside of the halls of legislation.[180]

A law-making body may confer a measure of discretion on an administrative officer or board, but it must, at the same time, define the limits of that discretion and fix the rules or standards which must govern its exercise.[181] Thus, the legislature may delegate authority to a governmental agency to promulgate rules and regulations and to effectuate the purpose of such as are essential to detect, control, and suppress contagious diseases among domestic animals, and such regulations may be remedial and penal, but they cannot be extended beyond the scope of the act by implication or by construction.[182]

The administrative body may determine the state of facts upon which the ordinance operates, provided the legislature marks the boundaries of the discretion to be exercised.[183] It has been held that, during the administrative stage, no hearing is necessary in order to

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[179] Ex parte McGee, 185 Pac. (Kan.) 14.

[180] Korth *v.* City of Portland, 261 Pac. (Ore.) 895, at 899.

[181] Small *v.* Moss, 18 N. E. (2d) (N. Y.) 281 at 283, 284.

[182] Campoamor *v.* State Live Stock Sanitary Board, 182 So. (Fla.) 277; Rhea *v.* Board, 171 N. W. (N. D.) 103 at 110–12.

[183] Mecchi *v.* Lyon Van & Storage Co., 102 Pac. (2d) (Cal.) 422 at 425–6; Lux *v.* Milwaukee, etc., 15 S. W. (2d) (Mo.) 343 at 345; Olp *v.* Town of Brighton, 19 N. Y. Supp. (2d) 546 at 550–1.

justify orders and rulings by the administrative body.[184] Although the courts will give a liberal construction to provisions of the statute delegating authority to administrative bodies[185] the courts will also control any possible abuse of that discretion.[186]

F. General Authorities Re: Health Regulations

1. The Effect of Health Provisions Upon the Relationship of Landlord and Tenant

It has been held that where the owner of a building leases the lower floor thereof to a cigar manufacturer under a lease requiring the tenant to observe certain health regulations, and the tenant violates those regulations the owner is, nevertheless, personally liable for violations of building and health restrictions, although he did not create the conditions, and although the tenant may also be liable.[187]

Under an act providing that, if an owner or occupant of premises, where a nuisance exists, fails to comply with the order of the board of health for the suppression of the nuisance, the board may have the nuisance removed and bring an action in the name of the municipality to recover the expenses in removing it. The owner of a premises, on which property (constituting a nuisance) was left by his tenant, is responsible for the removal of such nuisance, where he has at all times been in full possession and control of the premises.[188]

When a landlord is, by municipal ordinance, required to equip his building with fire escapes, he cannot by lease impose such duties on, or shift such burden to, his tenants.[189] The installation of an oil burner in leased premises in violation of rules and regulations of the department of public safety, which contributed to accident, could be considered as evidence of the landlord's negligence, making the landlord liable for any injury to the tenant, caused by a boiler explosion. Finally, a landlord who is required by law to exercise due care toward a tenant in respect to certain matters is liable for positive acts of misfeasance in respect to such matters when they result in injuries to the tenant.[190]

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[184] New Hampshire Fire Ins. Co. *v.* Murray, 105 Fed. (2d) (C. C. A. 7th) 212 at 216.

[185] State *v.* Clark, 9 S. W. (2d) (Mo.) 635 at 638.

[186] City of New York *v.* Corn, 133 N. Y. Supp. 459 at 460; Chapin *v.* Hogan, 202 N. Y. Supp. 641 at 643–4.

[187] People *v.* Eno, 119 N. Y. Supp. 600 at 603-604.

[188] Moose *v.* Town Board of Health, 190 N. Y. Supp. 161.

[189] Mullins *v.* Nordlow, 185 S. W. (Ky.) 825 at 830–831.

[190] Beauvais *v.* Springfield Institute for Savings, 20 N. E. (2d) (Mass.) 957.

2. Evidence With Respect to Violation of Law

It has been held that notices from a bureau of fire prevention calling for structural changes in premises to make them comply with the law are not, in themselves, evidence of the violation of the statute so as to afford grounds for the dispossession of a tenant.[191]

3. Judicial Notice

The courts will take "judicial notice" of the purpose of installing perforated pipes in cellars and sub-cellars and of having them connected with valves on the outside of the building,[192] and of evils demanding legislation, the mischief intended to be remedied, and the importance of the public interests affected thereby.[193]

4. Notice, etc. in Summary Abatement of Nuisance

In the case of summary abatement of nuisances and other conditions in violation of health laws, notices and an opportunity to be heard are not ordinarily prerequisites to such action. It is certainly true, however, that the action of a city council, in finding that a structure was a nuisance, could not be considered arbitrary or unreasonable where there was sufficient evidence to sustain its findings and where the plaintiff had both notice and a full hearing.[194]

Where a source of filth and/or cause of sickness exists, it is not necessary, under the health statutes, to give the defendant notice before an order of the board of health to remedy such nuisance is made.[195]

It has been held that an information, charging the violation of a city sanitary code by the keeping of a rooster without a permit, should have been dismissed on defendant's motion, where the state offered no proof that a copy of the rules (referred to in defendant's permit to keep "chickens") was delivered to the defendant or that his attention was directed to any regulation prohibiting the keeping of roosters.[196] Although notice and an opportunity to be heard are matters of right in judicial proceedings, it is not necessarily so in administrative proceedings, the form or character of which may not require such procedure or the imperative necessity of which cannot

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[191] Castles *v.* Rovenger, 207 N. Y. Supp. 460 at 467.
[192] Lantry *v.* Hoffman, 105 N. Y. Supp. 353 at 354.
[193] Gregory *v.* Hecke, 73 Cal. App. 268 at 277.
[194] Gow Why *v.* City of Marshfield, 5 Pac. (2d) (Ore.) 696.
[195] Commonwealth *v.* Collins, 154 N. E. (Mass.) 266 at 267.
[196] People *v.* Filactos, 12 N. Y. Supp. (2d) 175.

await it.[197] The state, or a municipality to which the police power has been delegated, can exercise such police power to take or destroy private property in a summary manner where necessary for the public in an emergency requiring immediate action.[198]

5. Expenditures by the Municipality in Connection With the Removal of Dangerous Conditions

The expenditure of public funds by a municipality for the clearance of slum areas and for low rent housing pursuant to the housing authority law is a valid expenditure of public money for a "public purpose."[199]

A code section providing that, on failure of a property owner to install a sanitary toilet, the city may install one at the owner's expense, the cost thereof to be a lien on said property in favor of the city, and to be collected as other debts are collected or liens enforced, constitutes a valid exercise of the police power in the conservation of the public health, rather than an exercise of the taxing power (as in case of local assessments), and clearly imports a personal liability on such owner for the expense thereof, which may be collected by city by action of *assumpsit*, the provision for a lien being merely cumulative security.[200]

6. Discontinuance of Service by a Municipally Owned Utility

A water company, whether privately or publicly owned and operated, has a right to require of a consumer compliance with reasonable rules and regulations of service and the payment by him of all charges lawfully due for such service, and to provide for the discontinuance of the service for the violation of such rules and/or the non-payment of such charges.[201] Similarly, a water company can require a consumer to so apply water as not to menace the safety, stability or usefulness of the water system and as not to affect injuriously other consumers; and, where the method of a consumer's use of water, in operating a passenger elevator, injuriously affects the system and

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[197] Nulter *v.* State Road Commission of West Virginia, 193 S. E. (W. Va.) 549 at 551.

[198] Vanderhoven *v.* City of Rahway, 1 Atl. (2d) (N. J.) 303 at 304; State *v.* Quattropani, 133 Atl. (Vt.) 352 at 353; Hartman *v.* Mayor, etc. of Wilmington, 41 Atl. (Del.) 74; Sprigg *v.* Town of Garrett Park, 43 Atl. (Md.) 813; Draxton *v.* Fitch, 207 N. W. (Minn.) 639.

[199] Stockus *v.* Boston Housing Authority, 24 N. E. (2d) (Mass.) 333 at 336.

[200] Town of Leeds *v.* Cason, 116 So. (Ala.) 519.

[201] Schultz *v.* Town of Lakeport, 5 Cal. (2d) 377 at 381.

other consumers, this fact warrants a discontinuance of the water service upon the refusal of the consumer to change such method of operation.[202]

Thus, a water company has the right, under rules and regulations to that effect, to shut off the water of a customer until he has complied with the company's reasonable request to make such improvements in the plumbing as will prevent such leaks as have been revealed by the water company's investigation and inspection.[203]

7. Right of Access to Premises

Administrative officers, in connection with the enforcement of the health laws, have the right of reasonable access to the premises of an individual or corporation. In that regard, it has been held that where a public nuisance is maintained, which injures the public, an officer representing the public may, where authorized by statute, enter upon the lands and premises of the party guilty of maintaining such nuisance (provided such officer can do so in a peaceable manner) and may remove or abate such nuisance, provided he does no greater injury than is necessary to accomplish such abatement.[204]

8. Requirements of Inspection and/or the Granting of a Certificate Therefor

It has been held that, under a sanitary code, any reasonable condition may be imposed by the village health officer as a condition precedent to the issuance of a permit to sell milk in the village, and that he is not limited to conditions stated in the code, provided the additional provisions are reasonable.[205]

Also, in an action for failure of performance under a building contract, it was held that the fact that an inspector of the city building department and an inspector in the bureau of health had each passed the building while the same was in the process of erection did not preclude one of the contracting parties from showing a violation of the building code and/or the health laws in the construction thereof.[206]

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[202] Kimball *v.* Northeast Harbor Water Co., 78 Atl. (Me.) 865 at 866-7.

[203] Salaban *v.* East St. Louis and Interurban Water Co., 1 N. E. (2d) (Ill.) 731 at 733; Milleville Improv. Co. *v.* Milleville Water Co., 113 Atl. (N. J.) 516 at 517; Ten Broek *v.* Miller, 216 N. W. (Mich.) 385-6; Dodd *v.* City of Atlanta, 113 S. E. (Ga.) 166-167.

[204] Eccles *v.* Ditto, 167 Pac. (N. M.) 726.

[205] Village of Herkimer *v.* Potter, 207 N. Y. Supp. 35.

[206] Brainard *v.* Ten Eyck, 168 N. Y. Supp. 116 at 118-20.

9. Remedy of Mandamus

The remedy of *mandamus* may be used to force the issuance of a permit or to prohibit the enforcement of the permit provisions of an ordinance.[207]

10. Ineffectualness of the Defense That Another Was Guilty of a Similar Violation of an Ordinance

A person charged with a violation of an ordinance cannot base a claim of discrimination in the manner of its enforcement upon the mere fact that there are several violations similar to his, operating within the same district, where it does not appear that they are operating with the consent of the city authorities, or that criminal prosecutions have not been instituted against those carrying them on.[208] For instance, it is no defense to a suit for creating a nuisance by befouling a stream that others are also engaged in committing similar acts.[209]

11. Enforcement of Health Laws Against Water Consumers

a. In General: A prosecution for the violation of a fire prevention ordinance, providing that each day's occupation of a building not properly equipped with an automatic sprinkler shall be a separate offense, cannot be barred so long as the building was occupied while not so equipped as required.[210]

An ordinance which imposes a penalty for failure to file with the secretary of a board of health a plan of the contemplated plumbing work, "signed by the owner," will not be held to impose a liability to such a penalty upon the plumber who may be engaged by the owner to do the work. The duty imposed by the ordinance is cast upon the owner; and he only is liable for such failure.[211]

In an action to recover a penalty for an alleged violation of a sanitary code, providing that all offensive odors arising from the handling of meat, and the treating of or caring for offal, blood, or any other material, stored or manufactured, must be cared for by destruction or condensation, and not allowed to escape into the out-

[207] Huppent *v.* Hague, 130 Atl. (N. J.) 364; Richardson *v.* Coker, 3 S. E. (2d) (Ga.) 636, 641.

[208] Ex parte Quong Wo, 161 Cal. 220.

[209] Indianapolis Water Co. *v.* American Strawboard Co., 57 Fed. (C. C. Ind.) 1000 at 1003.

[210] City of Chicago *v.* Washingtonian Home of Chicago, 124 N. E. (Ill.) 416 at 418.

[211] Board of Health *v.* Werner, 50 Atl. (N. J.) 585.

side air, it is no defense that the defendant had installed a good system for taking care of the odors, and that the odors which did escape arose from the fact that one of its pipes was defective, and that as soon as it learned of the defect in the pipe, it caused the pipe to be repaired, since the liability is predicated upon the intentional violation of its provisions.[212]

b. Arrest and Prosecution: In prosecutions for the violation of health regulations, the burden rests upon the plaintiff, ordinarily, to prove all the essential elements of the offense charged. Where a failure to comply with a health regulation has been shown, one charged with such failure has the burden of showing facts to establish a justification or excuse therefor. In such a proceeding, the promulgation of a regulation by a board of health may be shown by the certificate of the secretary of the board to have been duly enacted and published.[213]

Those persons and/or corporations, subject to the provisions of any health ordinance, who violate the ordinance, are subject to arrest and prosecution at the instigation of the proper health officers.[214] It has been held, however, that a statute authorizing the arrest of offenders without a warrant is inoperative if the officers are trespassers engaged in an unauthorized search of the premises.[215]

c. Injunction: The remedy of the administrative body or officer may be by way of an injunction against the consumers.[216] In this connection, however, it has been held that, in determining what constitutes a nuisance, the questions of time, location and surrounding circumstances must be considered; and what might be a nuisance in one locality because of the density of the population, the residential character of the neighborhood or similar circumstances, may be entirely proper in another.[217]

d. Applicability of Penal Provisions to Public Officers: It has been said, in the case of *Parsons* v. *Town of Smithtown*,[218] that:

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[212] Dept. of Health *v.* Sulzberger & Sons Co., 137 N. Y. Supp. 998.

[213] 25 Am. Jur. Health 318, §41.

[214] Board of Health *v.* Hayes, 74 Atl. (N. J.) 339; State *v.* Hall, 119 Atl. (Vt.) 884; People *v.* Reisner, 295 N. Y. Supp. 813; People *v.* Giorgi, 16 N. Y. Supp. (2d) 923; State *v.* Beery, 270 N. W. (Minn.) 600; Coursey *v.* City of Andalusia, 134 So. (Ala.) 671.

[215] Custer *v.* State, 36 S. W. (2d) (Tex.) 504.

[216] Board of Health *v.* Ihnken, 67 Atl. (N. J.) 28; State *v.* Chemical Co., 107 Atl. (N. J.) 164; Town of Gallup *v.* Constant, 11 Pac. (2d) (N. M.) 962.

[217] City of Pana *v.* Central Washed Coal Co., 102 N. E. (Ill.) 992 at 999.

[218] Parsons *v.* Town of Smithtown, 288 N. Y. Supp. 470.

"The theory of the plaintiff's cause of action is that the court should exempt him and the officers and employees of the department of mental hygiene from the scope and effect of the ordinances and to create a shield against prosecutions about to be commenced for their enforcement. I am not persuaded that the court has the power that is sought to be invoked, or, if it has, that it should be exercised to create such an exemption.

"A state officer may not, by the manner in which he chooses to perform the duties of his office, place himself beyond the operation of a valid penal ordinance. He is favored by no greater immunity against the criminal process than the private citizen. This applies, it seems to me, with special force in respect to an ordinance for the protection of public health. If the act prohibited affects the public health, it serves no purpose whatever, if one class of citizens, even public officials, be allowed to violate it, while another class, private citizens, are restrained by its provisions. The futility of the ordinance, under such a dual arrangement for enforcement, is plainly apparent."

V. Illustrative Statutory Provisions Re: Public Health

A. In Jurisdictions Other Than California

A reference to the Appendix of the Goudey paper (see p. 458 of this issue of the JOURNAL) will furnish ample citations and illustrations of legislation in other jurisdictions designed to effect the elimination and/or control of cross-connections, inter-connections and back-flow.

B. Constitution and Laws of California

1. California Constitution

The California Constitution provides[219] for the organization of what is known as a "Freeholders' Charter City" which, within the exterior boundaries of the city, is supreme on all matters of "municipal concern" (sometimes referred to as a "municipal affair"). This supremacy extends to matters of public health, safety and welfare only to the extent that any laws or ordinances adopted by the city shall be supplemental to and/or designed to effect regulations in addition to any state laws covering the subject matter in question. In this regard, however, attention is called to another provision in the same constitution[220] where it is provided that "any county, city,

[219] Article XI, §6.
[220] Article XI, §11.

town, or township may make and enforce within its limits all such local, police, sanitary, and other regulations as are not in conflict with general laws."

2. General Laws and the Health and Sanitary Code

Attention has already been called to the pertinent provisions of the "pure water law"[221] and to those provisions of the health and sanitary code and of the penal code relative to the penal provisions of those acts.[222] All of the pertinent provisions of the California General Laws, in 1939, were incorporated in what is presently known as the California Health and Safety Code.[223] The pertinent provisions of this code may be summarized, as follows:

a. The state health department shall examine and may prevent the pollution of sources of public domestic water.[224]

b. Said board may maintain and institute all necessary actions and proceedings to enforce its rules and regulations to enjoin and abate nuisances dangerous to health, to compel the performance of any act specifically enjoined upon any person, officer or board by any law of the state, and to protect and preserve the public health.[225]

c. Said board may abate public nuisances[226] and may advise all local health authorities; and, when necessary, may control and regulate their action.[227]

d. Said board may adopt and enforce rules and regulations in connection with its duties and shall make reports to the state legislature relative to suggested legislative action.[228]

e. County health officers shall report to the state department all violations of state health laws; and the same duty is enjoined upon town and city health officers.[229]

f. Each city health officer shall enforce and observe all orders and ordinances of the governing body of the city pertaining to public health; all orders, quarantine regulations and public health rules

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[221] Deering's General Laws, Act 9111, §§1–2, as amended pp. 4267–69–70.

[222] California Penal Code, §378; California Health and Safety Code, §4457, p. 103.

[223] Statutes of 1939, chap. 60, approved April 7, 1939, effective September 19, 1939.

[224] §203.

[225] §205.

[226] §206.

[227] §207.

[228] §§208–209.

[229] §§453, 505.

prescribed by the state department of health; and all statutes relating to public health.[230]

g. The code provides detailed and comprehensive provisions for the formation of local health districts in situations where such information may be necessary or convenient due to the non-existence or non-functioning of local town, city and county health departments.[231]

h. In the case of local epidemics of disease, the local health officer shall report to the state department of health all facts concerning the disease; and the state department shall take measures to abate the same and prevent its spread.[232]

i. The failure of any person to observe the demand of a state health officer, or the refusal or neglect of any person to conform to any rule, order, or regulation prescribed by the state department shall be considered a misdemeanor,[233] and each day that any such violation continues shall be considered a separate offense.[234]

j. The washing of clothes in any spring, stream, river, lake, reservoir, well, or other waters used or intended for use for drinking purposes, is prohibited; and a fine and/or imprisonment is imposed for each day's violation thereof.[235]

3. California Rules and Regulations re: Cross-Connections

From a consideration of the health laws of California, it may be deduced that the State Board of Health can (and does) establish such "rules and regulations" as may be necessary or convenient to the proper administration of the laws. It also appears that city health authorities, either expressly or impliedly, are given the power, and have imposed upon them the duty, of assisting state authorities in the enforcement (within the city boundaries) of such state laws. In the City of Los Angeles, however, it is possible that only the Department of Health of Los Angeles is presently to be considered such an "assisting" body under the act. It is doubtful, under the present state health laws, that inspectors and other representatives of the Department of Water and Power have any (police power) law

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[230] §504.
[231] §§900–970, inclusive.
[232] §2968.
[233] §2600.
[234] §2602.
[235] §4456.

enforcement authority except such as may have been delegated to them in the capacity of deputy state health officers, deputy city health officers, and/or special police. Of course, if a misdemeanor were committed in the presence of an "inspector" of the Department, he might (as could any private citizen) make an arrest, provided that, in making such arrest, he complied with the provisions of the Penal Code of the State of California.

On the other hand, the rules and regulations of the State Board of Health, together with the state laws themselves (as has already been noted), impose upon the Department a very stringent duty and liability with respect to the maintenance, and continuance, of an adequate and safe water supply. In the event of contamination of the city water supply (in addition to a civil liability, which might be imposed both on the Department and on its officers) the Department might face revocation of its water supply permit and its officers might face criminal fines and/or punishment. For this reason, the Department should take, and would be justified in taking, all available legal steps to effect an immediate removal of any and all conditions (including dangerous plumbing and water piping connections affecting, or threatening to affect, the purity and potability of the city water supply.

Attention has already been called to the rule and regulation of the State Board of Health with reference to cross-connections.[236]

4. County and Municipal Ordinances and Health District Ordinances Generally

In California most of the counties and the "sixth class" cities (which comprise most, if not all, of the cities in the state, other than "Free-holders' Charter Cities") follow in their supervision and control of public health the general provisions of the California Health and Safety Code. The same is true with respect to those few instances in which health districts have been formed pursuant to the provisions of the code.[237] In many localities, however, the chief, if not the only, control of public health is exercised by deputies, in the office of the state health officer, who act under the supervision and direction of the State Board of Health.

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[236] Rules and Regulations, California State Board of Health, November, 1919, amended May 12, 1924.

[237] Bellerive Inv. Co. *v.* Kansas City, 13 S. W. (2d) (Mo.) 628 at 634–5.

C. Health and Sanitation in Freeholders' Charter Cities

For purposes of illustration, reference is again made to the City of Los Angeles. In this connection, again, the attention of the reader is called to that portion of this paper in which the police power of such cities is discussed.[238]

1. Provisions of the Charter of the City of Los Angeles

In Section 2 (pp. 6, 7), the Charter empowers the city as follows:

"(4) To make and enforce all laws and regulations in respect to municipal affairs, subject only to the restrictions and limitations provided in this charter; provided, however, that nothing herein shall be construed to prevent or restrict the city from exercising or consenting to, and the city is hereby authorized to exercise, any or all rights, powers and privileges heretofore or hereafter granted or prescribed by general laws of the state.

"(5) To exercise any or all rights, powers, privileges and procedures now or hereafter established or authorized for municipalities, or for the City of Los Angeles, by any law of the State of California, by this charter, or by other lawful authority.

"(6) To make and enforce within its limits all such local, police, sanitary, safety, welfare and other regulations as are not in conflict with the general laws, and to exercise such jurisdiction outside its limits in such manner as may be authorized by law."

Again in Section 2 (pp. 9, 10) the Charter reads as follows:

"(11) Among the rights and powers which may be exercised by the City of Los Angeles, are the following, this enumeration being a partial enumeration and in no sense a restriction or limitation upon the rights and powers of the city; . . .

"(a) To enforce law and promote the public peace, health, safety and welfare; (b) to enact ordinances and provide punishment for the violation thereof; . . . ."

In Los Angeles the power and duty[239] to enforce ordinances and laws relative to plumbing and to the construction and removal of buildings is lodged in the Department of Building and Safety.[240] The city also has a department of health invested with the power and duty of supervising and controlling sanitary conditions and the

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[238] Boyd *v.* City of Sierra Madre, 41 Cal. App. 520 at 523; see also references given in footnotes 58 through 80, *supra*.

[239] Statutes of 1925, p. 1024, as amended.

[240] Statutes of 1925, p. 1024, §90.

general health of the people[241]; and the control and supervision of the supply and distribution of water is vested in a Department of Water and Power.[242]

2. Ordinances and/or Code Provisions of the City of Los Angeles

The Council of the City of Los Angeles from time to time has adopted ordinances designed to put into effect the aforementioned provisions of the City Charter. These ordinances have been incorporated into a municipal code[243] and separate articles are used to incorporate those provisions of the code relating to the several governmental departments of the city. The Department of Water and Power, being a so-called proprietary agency of the city, is not included (except in a few scattered instances) within the terms and provisions of the code. It would serve no useful purpose to attempt here to set forth at length the provisions of the code with reference to the powers and duties of the Department of Health and those of the Department of Building and Safety.

With respect to the Department of Health there are very few provisions relating to the control of sanitation and of the potability of the domestic water supply. Goudey has pointed out, in the appendix of his paper, those portions of the Municipal Code which apply to the water supply served by the Department of Water and Power.

The Department of Building and Safety has recently adopted a so-called "cross-connection and back-siphonage" ordinance, which is designed to control back-flow and back-siphonage in plumbing fixtures.[244]

The over-lapping of the respective jurisdictions of the aforementioned Departments of Building and Safety, Health, and Water and Power, brings into focus one of the major problems of health and sanitation administration. As indicated by Goudey, there is no uniformity throughout the several states with regard to placing in the hands of one administrative body the entire control of the elimination and regulation of cross-connections, inter-connections and back-flow, especially that control relating to a safe domestic water supply. From the legal point of view, it would seem desirable

[241] Statutes of 1925, p. 1024, §§150, 152.

[242] Statutes of 1925, p. 1024, §220, (1), (2).

[243] Effective date, November 12, 1936.

[244] Ordinance No. 80,070 (§94.62 et seq., Municipal Code) adopted September 6, 1938.

to have the control, regulation, inspection and protection of such domestic water supply delegated to, and in the hands of, a single, competent administrative board which, through highly trained officers and employees, not only would determine the existence or non-existence of conditions inimical to the health and safety of the inhabitants of a city, but would, through its control of the issuance or non-issuance of permits, prevent the installation of pipes, fixtures and equipment which would contribute to, or be the cause of, the pollution of such domestic water supply.

Under the present ordinances of Los Angeles, the police power, with respect to health and sanitation, is lodged both in the Department of Health and in the Department of Building and Safety. There is no ordinance covering "water" connections (as distinguished from "plumbing" connections). This fact, and the fact that it is often necessary for the water supply agency to act quickly in removing or preventing pollution of its water supply, lead to the conclusion that it might become advisable to draft, and to place before the City Council, a proposed ordinance which would be comprehensive in its scope, and which would cover all phases of water piping, water connections, plumbing and other matters which may, or do, affect the delivery of a safe, pure and wholesome water supply. To this end, inspectors would be granted certain police powers, including the right to enter for inspection, to abate summarily conditions of actual contamination, and to take effective steps by notice, or other means, to abate all other hazardous conditions.

VI. Rules and Regulations of Los Angeles Departments

A. Department of Health

In so far as the Department of Health of the City of Los Angeles is concerned, there seems to be no published set of rules and regulations; but, from time to time, general bulletins and orders are issued regarding city-wide health conditions. So far as the writer knows, the Department has never issued any general bulletins, rules, or regulations with reference to the actual, or potential, contamination of the domestic water supply, other than bulletins with respect to an already existing pollution which resulted in, or was likely to result in, an epidemic, such as those advising the public to boil its water prior to drinking it. In specific instances, of course, the chief health officer and/or his inspectors, have, by letter or order, directed a particular individual or corporation to remove or abate a condition dangerous to public health.

B. Department of Building and Safety

As in the case of the Department of Health, the Department of Building and Safety confines its promulgation of rules and regulations primarily to individual cases; although, in connection with the so-called "Electric Code," the Department, from time to time, does keep on file "service requirements," which are detailed and descriptive of the general provisions of the code. Also, from time to time, this Department issues bulletins to manufacturers and dealers in plumbing fixtures, and to master plumbers and their assistants, relative to "approved" types of fixtures, valves, appliances, etc. Supplementing the work of the Department of Building and Safety is that of the Board of Mechanical Engineers, which has the supervision and control of such fixtures and equipment as hydraulic elevators and lifts, as well as of steam boilers and heating apparatus.

C. Department of Water and Power

Pursuant to the provisions of the Charter of the City of Los Angeles,[245] the Department of Water and Power has adopted, and is enforcing, water service rules and regulations covering many phases of the service and supply of domestic water. With respect to the control of cross-connections, inter-connections and back-flow, however, there are only two rules presently in force which might be said to assist the Department in such regulation. The first is a rule with respect to inspection,[246] which reads as follows:

"Employees of the Bureau shall be admitted to consumer's premises during reasonable hours for the purpose of testing, changing or reading water meters installed and/or of making general inspection of water usage, wastage, etc. Employees of the Bureau engaged in such work will be furnished with, and on request will display to the consumers, appropriate evidence of identification."

The second is a rule which has been, or is about to be, adopted, and which covers "discontinuance of service" for violation of the rules and regulations.[247] This rule reads as follows:

"The recital of specific instances in these Rules and Regulations wherein the Department of Water and Power is authorized to discontinue service to the consumer is not to be construed as limiting the

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[245] Statutes of 1925, p. 1024, §82.

[246] Rule and Regulation No. 56.

[247] Rule and Regulation No. 52½. (As of the date this article goes to press, said department has in force and effect 3 new rules, Nos. 58, 59 and 60, relative to cross-connections, etc.)

authority of the said Department to the instances specified. To the contrary, the said Department shall have the general right to discontinue service to the consumer for the latter's failure of compliance with or violation or infraction of any of these Rules or Regulations or amendments or additions thereto, which may then be in force, after notice to the consumer to remedy such noncompliance and/or to desist from such violation or infraction and a reasonable opportunity thereafter within which to comply with said notice, provided however that no such notice need be given where the noncompliance with or violation or infraction of the Rules and Regulations by the consumer results, or is likely to result, in a dangerous or unsanitary condition on the consumer's premises or in the Department's water system or elsewhere, or where discontinuance of service is necessary to protect the Department from fraud, imposition, loss or abuse."

D. General Observations Re: Rules and Regulations

If the ideal system hereinabove suggested—i.e. the delegation of all control of water supply problems to one administrative body or official—was adopted, it would then be possible for that administrative body or official to adopt such rules and regulations and "water service requirements" as would effectually supplement and interpret the provisions of the Health and Sanitary Code or any health ordinance adopted by the City Council. These rules and regulations and water service requirements would be so arranged and so elaborated as to simplify greatly the task of both the inspector and the employee, in enforcing the law, and the skilled technician, the contractor, and the consumer, in complying with the provisions of the law.

The Sanitary Engineering Division of the Bureau of Water Works and Supply of the Department of Water and Power has, from time to time, succeeded, at least partially, in effecting this desired end by two methods—by supplying its inspectors and other employees with "manuals" which contain references to, and somewhat detailed interpretations of, all laws with respect to the sanitation of public water supplies and all official or unofficial rules and regulations relative and supplemental thereto, and by furnishing interested persons, such as master plumbers, oil well superintendents, etc., with mimeographed or printed bulletins containing diagrams and detailed specifications by which they may more easily, efficiently, and economically comply with the law. In addition to these services, the

inspectors, from time to time, give personal assistance and advice to individual persons or corporations relative to specific methods of control and/or elimination of cross-connections, inter-connections and back-flow.

VII. Proposed Ordinance Re: Cross-Connection, Inter-Connection and Back-Flow Protection

Throughout this discussion has been noted the lack of uniformity with respect to health and sanitation laws, codes and ordinances throughout the United States and, in many instances, the entire lack of provisions designed to effect the elimination and/or control of specific types of pipes, equipment and fixtures contributing to, or causing, actual or potential health hazards. Reference has also been made to the appendix of Goudey's paper, in which is incorporated most of the pertinent provisions of presently existing laws and ordinances bearing upon these questions.

It has been, and is, the desire of Mr. Goudey and of the author, to present for the information and approval of the representatives and members of the American Water Works Association, and other interested parties, a proposed form of ordinance which would attempt to cover comprehensively all the provisions considered necessary for a proper, complete and efficient control and/or elimination of cross-connections, inter-connections and back-flow. We realize, of course, that such an initial effort will be, and undoubtedly is, incomplete and perhaps unwieldy, in several respects; but if, by such presentation, we can arouse the interest of, and obtain a great number of suggestions, comments and observations from, the readers of these two papers, we will have accomplished our purpose and will have started a movement which should be productive of real benefit to most, if not all, of the political subdivisions and water companies throughout the country.

It is also realized that the constitution and/or general laws of a particular state may make it impossible or difficult to adopt and/or use all of the provisions of the proposed ordinance. It will also undoubtedly be true that in particular localities the administrative authorities would be forced to adopt variations of, or to promulgate provisions entirely at variance with, those presented herein. It would be preferable, of course, if, under the constitution of a particular state, the legislature could adopt a state-wide code of health

and sanitation, which would incorporate, at least in generalities, all of the provisions of the ordinance here proposed. It would then be possible for each political subdivision to adopt by reference, through charter, ordinance, or board resolution, all, or the more pertinent portions, of such state code; and each such provision so adopted could then be supplemented by rules and regulations and water service requirements, which would adapt such provisions to the particular problems of a given locality.

A proposed ordinance, drafted to illustrate the above proposals, together with the author's comments and observations, legal and otherwise, with respect to some portions thereof, is presented in the following section.

Appendix

Proposed Ordinance Re: Cross-Connection, Inter-Connection and Back-Flow Protection

NOTE: As indicated in the text of this paper, it would be preferable if the legislatures of the various states could, and did, adopt a state-wide code of health and sanitation, including within its scope the substance of the ordinance proposed herein. It may be that, pending the putting in motion of the legislative wheels, state boards of health may, if their powers be broad enough, adopt "Rules and Regulations" which would serve somewhat the same purpose.

This proposed ordinance is, for the most part, a recapitulation of the best and most effective provisions adopted by one or more of the several states, which provisions have been set forth in the Appendix to the Goudey paper. The writer, (as well as Mr. Goudey) will welcome any suggestions as to additions, amendments and/or deletions to, and from, this proposed ordinance.

Ordinance No.——

(Title of Ordinance)[1]

THE PEOPLE OF MODERN CITY DO ORDAIN AS FOLLOWS:

Section 1. Repeal of Inconsistent Ordinances and Municipal Code Sections.[2]

Sec. 2. Addition to Modern City Municipal Code of New Article —, Chapters First to Eighth, Inclusive, Sections 101.1 to —, Inclusive.

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[1] Such matters as the "Title" of the Ordinance have been omitted for the reason that the "entitling" of any legislative enactment, be it state or city, must, and will, follow the particular requirements, procedures, practices and precedents then in force and effect in the particular adopting state and/or municipality.

[2] The fundamental principle underlying the proposed Ordinance is that *one* department of the municipal government would administer and enforce all of the provisions of the law with respect to the supply, distribution and sanitation of the domestic water supply. The writer holds no brief for any particular department as being the one best suited for such administration and enforcement, but he does suggest that, in any given political subdivision, the department best suited for such activity will be that which has the trained personnel and the available budget necessary to provide the most effective and comprehensive performance of such duties. It would be necessary, therefore, in almost every instance for the new provisions to provide specifically for the repeal of all inconsistent laws and/or ordinances.

Article ————

Chapter First—General Provisions

Sec. 101.1. Short Title

This Article shall hereafter be referred to as the "Water Supply Code."[3]

Sec. 101.2. Effective Date

This Article shall be and become effective — days from and after the date of the first publication hereof.

Sec. 101.3. Retroactive Application[4]

Subject to the provisions hereof with respect to "notice" and "ability to be heard," the provisions of this Article shall as of, and at and after, the effective date hereof, be binding upon any and all persons maintaining, operating, owning and/or controlling, and shall be effective and applicable with respect to any and all properties, matters and/or things herein in this Article referred to, whether the same shall have existed prior to said effective date or shall thereafter exist.

Sec. 101.4. Grammatical Interpretation

Sec. 101.4.1. Genders.

Sec. 101.4.2. Singular and Plural.

Sec. 101.4.3. Tenses.

Sec. 101.4.4. Use of Words and Phrases.

Sec. 101.4.5. Applicability of State Code Provisions re: Interpretation.

Sec. 101.4.6. Reference to Code in Prosecutions and Its Designation in Ordinances.

Sec. 101.4.7. Existing Law Continued Wherever Applicable.

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[3] In line with the discussion of the purposes set forth, the Ordinance, or Article, in question might well and properly be referred to as the "Water Supply Code."

[4] As noted in the text of the paper, provisions of the law which have a retroactive operation are strictly construed against the enforcing body and the burden of proof upon such enforcing body with respect to establishing the existence of a condition dangerous or hazardous to public health and safety is much greater under such a law. If, however, the Article, as adopted, *specifically* provides for a retroactive operation, and for a reasonable means and method of administrative enforcement thereof (including "notice" and an "opportunity to be heard"), such a provision will, in most instances, be upheld by the courts.

Sec. 101.4.8. Construction—Promotion of Justice.

Sec. 101.4.9. Effect of Code on Past Actions and Obligations Previously Accrued.

Sec. 101.4.10. Interpretation of Chapter, Section, Sub-Section and Sub-Sub-Section Notes.[5]

Sec. 101.4.11. Reference to Specific Ordinances.

Sec. 101.4.12. Section Headings—Effect of.

Sec. 101.4.13. Reference to Acts or Omissions—Jurisdiction Within City.[6]

Sec. 101.4.14. Notices—Service of.

Sec. 101.4.15. Proof of Notice.

Sec. 101.4.16. Prohibited Acts—Causing, Permitting, Suffering, Aiding and/or Abetting.

Sec. 101.4.17. Validity of Code.

Sec. 101.4.18. Public Nuisances—Violations of This Article.

Sec. 101.4.19. Each Day's Violation a Separate Offense.

Sec. 101.4.20. Penalties Recoverable by City in Civil Action.

Sec. 101.4.21. Adoption of Rules, Regulations and "Water Service" Requirements by Department of ———.[7]

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[5] The ordinance proceeds upon a basic key number of 100. Each chapter is reflected in such key number by the number appearing in the unit column. For instance, Chapter 1 would be noted by the key number 101. The section number is provided by the addition to the key number of a period and a numeral immediately succeeding it, so that Section 5 in Chapter 1, would be designated 101.5. The sub-section number is obtained by adding to the number last described another period and a numeral corresponding to the sub-section. For instance, Chapter 1, Section 3, Sub-Section 2, would be noted 101.3.2. Correspondingly, sub-sub-sections are indicated by the addition of still another period and numeral. For instance, Chapter 3, Section 8, Sub-Section 10, Sub-Sub-Section 5, would be indicated thus: 103.8.10.5.

[6] Normally, the police power jurisdiction of a municipality and/or of a state, does not extend beyond the territorial boundaries of the political subdivision in question. As noted in the text of the paper, however, the city or state may, in special instances, provide for a reasonable extra-territorial application of the law in question where such operation is reasonably necessary to the proper enforcement of the law and control of the danger or hazard sought to be avoided or eliminated.

[7] As to the "Department," the problem with respect thereto has been indicated in the introductory note and Footnote 2, *supra*. It is not only lawful, but quite necessary and desirable, that any such department adopt rules and regulations which will serve both as a notice of, and a source of information with respect to, the administrative duties of health law enforcement. The so-called "Water Service Requirements" would be printed or mimeo-

Sec. 101.4.22. Co-operation With Other Departments.[8]

Sec. 101.4.23. Violations of Article a Misdemeanor—Fine and/or Imprisonment.

Sec. 101.4.24. Repeal of Conflicting Ordinances and/or Code Provisions.

Chapter Second—Definitions[9]

Sec. 102.1. General Words

The following general words and phrases, whenever and wherever used in this Article, shall be construed as defined in this chapter unless from the context a different meaning is intended, or unless a different meaning is specifically defined and more particularly directed to the use of such words or phrases.

Sec. 102.1.1. Board.

Sec. 102.1.2. City.

Sec. 102.1.3. Department.

Sec. 102.1.4. Division.

Sec. 102.1.5. Office.

Sec. 102.1.6. Officer.

Sec. 102.1.7. Person. The word "person" shall mean natural person, joint venture, joint stock company, partnership, association, group, company, corporation, business trust, organization or the

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graphed sets of detailed specifications and data which would supplement the aforementioned rules and regulations and would be particularly helpful to engineers, inspectors, plumbers, contractors, and other persons vitally interested in proper installations and proper methods of effecting elimination of health hazards.

[8] As the proposed ordinance is not designed to effect a control of the mechanical and general installation aspects of plumbing and water piping, connection, fixtures, etc., the control of these latter matters would be retained by the particular department or departments now charged with their enforcement and control. It would be necessary, therefore, for the department charged with protection of the water supply, from a sanitation point of view, to co-operate closely with these other departments in effecting a general plan of action and a general educational program designed to acquaint all interested parties, including the general public, with the problems and necessities of public health and sanitation control.

[9] Except in a few instances where it seemed desirable to define specifically words of unusual importance, the writer has not attempted to set forth anything other than a designation of the word to be defined and which, in such a code, probably should be defined. Undoubtedly, there are many others which the reader could, and would, suggest in that connection.

manager, lessee, agent, servant, officer, employee, executor, administrator, successor in interest and/or assign. Such word, as used herein, shall also include water distribution and sewer design engineers, water main repairmen and operators, architects designing private piping systems, boiler room, steam plant, and water treatment engineers, journeymen and master plumbers, inspectors of health, water, building and plumbing, boiler and elevator departments, fire insurance inspectors and fire department.

Sec. 102.1.8. Shall and May.

Sec. 102.1.9. Written.

Sec. 102.2. Specific Words

The following specific words and phrases, whenever and wherever used in this Article, shall be construed as defined in this chapter unless from the context a different meaning is intended, or unless a different meaning is specifically defined and more particularly directed to the use of such words or phrases.

Sec. 102.2.1. "A" Words.

Sec. 102.2.1.1. Air Gap.

Sec. 102.2.1.2. Approved. "Approved" shall mean satisfactory and acceptable to said Board; provided, however, that whenever the word "approved" applies to the method of installation it shall be deemed to mean satisfactory and acceptable to the inspection division of said Department, except when and as otherwise determined by said Board; and provided, further, that materials, devices, appliances, apparatus, or equipment complying with the standards of said Department and listed by, or bearing the label of inspection of the inspectors of, said Department, shall be deemed to be approved and to comply with the provisions of this Article, except when and as otherwise determined or disapproved by said Board; and provided, further, that this definition shall not be deemed or construed to permit, allow or authorize the use of any material, device, appliance, apparatus or equipment for any other purpose than that for which it was approved, nor in any manner which will be in violation of any provision of this Article.

Sec. 102.2.1.3. Aspirator.

Sec. 102.2.2. "B" Words.

Sec. 102.2.2.1. Back-Flow.

Sec. 102.2.2.2. Back-Flow Valves.

Sec. 102.2.2.3. Back-Siphonage.
Sec. 102.2.2.4. Bidets.
Sec. 102.2.3. "C" Words.
Sec. 102.2.3.1. Cellar Drains.
Sec. 102.2.3.2. Combination Faucets.
Sec. 102.2.3.3. Contamination.
Sec. 102.2.3.4. Continuous Waste and Vent System.
Sec. 102.2.3.5. Cross-Connections.
Sec. 102.2.4. "D" Words.
Sec. 102.2.4.1. Dangling Hoses.
Sec. 102.2.4.2. Devices.
Sec. 102.2.4.3. Direct Cross-Connection.
Sec. 102.2.4.4. Direct Waste Connection.
Sec. 102.2.4.5. Discharge Side.
Sec. 102.2.4.6. Double Check Valve.
Sec. 102.2.4.7. Dual Water Supply.
Sec. 102.2.4.8. Drain.
Sec. 102.2.5. "E" Words.
Sec. 102.2.5.1. Elevator.
Sec. 102.2.6. "F" Words.
Sec. 102.2.6.1. Fire Sprinkler Connection.
Sec. 102.2.6.2. Fire Sprinkler System.
Sec. 102.2.6.3. Flooded.
Sec. 102.2.6.4. Force of Back-Flow. The force of back-flow shall include vacuums, pressures created by pumps, drops in pressure, and independent pressure or vacuum sources.
Sec. 102.2.6.5. Flush-O-Meter.
Sec. 102.2.6.6. Flush-O-Meter Type Toilet.
Sec. 102.2.6.7. Flush Tanks.
Sec. 102.2.6.8. Flush Valve.
Sec. 102.2.6.9. Frost-Proof Toilet.
Sec. 102.2.7. "G" Words.
Sec. 102.2.8. "H" Words.
Sec. 102.2.8.1. Hose Bib.
Sec. 102.2.8.2. Hose Connection.
Sec. 102.2.8.3. House Drain.
Sec. 102.2.8.4. House Sewer.
Sec. 102.2.8.5. Hydraulic.
Sec. 102.2.8.6. Hydraulic Elevator.

Sec. 102.2.8.7. Hydraulic Lift.

Sec. 102.2.9. "I" Words.

Sec. 102.2.9.1. Indirect Connection.

Sec. 102.2.9.2. Indirect Cross-Connection.

Sec. 102.2.9.3. Inlet.

Sec. 102.2.9.4. Inter-Connection. An inter-connection is any connection or physical arrangement within a hot and/or cold water piping fixture, equipment, and/or device, whereby the domestic water supply may be rendered bacteriologically unsafe, chemically poisonous and/or aesthetically objectionable. It shall be further defined to mean "any installation of hot or cold water piping, or any portion thereof, which is so arranged, connected or installed that it will be possible for used, unclean, polluted or contaminated water, mixtures or substances to: (1) enter any portion of such piping from any tank, receptacle, equipment or plumbing fixture by reason of back-siphonage, either during normal use and operation thereof or when any such tank, receptacle, equipment or plumbing fixture is flooded; or (2) be drawn into any portion of such piping from any tank, receptacle, equipment or plumbing fixture, by suction, either during normal use and operation thereof or when any such tank, receptacle, equipment or plumbing fixture is flooded; or (3) be introduced, forced, drawn or caused to flow into any portion of such piping by reason of any hose, tube or flexible or movable connection, the outlet or discharge end of which may be purposely or accidentally submerged.

Sec. 102.2.10. "J" Words.

Sec. 102.2.11. "K" Words.

Sec. 102.2.12. "L" Words.

Sec. 102.2.13. "M" Words.

Sec. 102.2.13.1. Master Plumber.

Sec. 102.2.13.2. Media of Back-Flow or Back-Siphonage. The media of back-flow or back-siphonage material shall include sewage, used or altered water, a dual water supply or liquids entirely foreign to water.

Sec. 102.2.14. "N" Words.

Sec. 102.2.15. "O" Words.

Sec. 102.2.15.1. Occupant.

Sec. 102.2.15.2. Over-Flow Connection.

Sec. 102.2.15.3. Over-Flow Fixture.

Sec. 102.2.15.4. Over-Flow Rim.

Sec. 102.2.15.5. Over-Head Discharge.

Sec. 102.2.15.6. Owner.

Sec. 102.2.16. "P" Words.

Sec. 102.2.16.1. Physical Arrangement of Inter-Connections. The physical arrangement of inter-connections shall include valves, overflows, drains, direct connections, check valves, extensions of the domestic water system, devices operated by water and plumbing fixture inter-connections.

Sec. 102.2.16.2. Physical Connection.

Sec. 102.2.16.3. Pipe.

Sec. 102.2.16.4. Plumbing. "Plumbing" shall include "water piping" and shall mean any sanitary plumbing, house drainage, soil pipe, waste pipe, vent pipe, house sewer, cesspool, septic tank, gas piping, gas water heater, gas water heater vent, or any pipe or piping for any similar purpose, together with all plumbing fixtures, or other fixtures or appliances therefor; but shall not include any rain water leader or down spout from the roof of a building, any water piping, any steam piping, any connection from a gas outlet to a gas fixture which is not more than six (6) feet in length, or any gas service pipe between a meter and the gas supply main.

Sec. 102.2.16.5. Plumbing Fixtures. "Plumbing fixture" shall include "water fixture" and shall mean any vessel, receptacle, appliance, equipment, area, space, depression, or other arrangement, for the disposal or elimination of waste liquid or solid substances, and which is provided and arranged with an outlet for connecting to any sanitary plumbing pipe or piping.

Sec. 102.2.16.6. Pollution.

Sec. 102.2.16.7. Public Supply.

Sec. 102.2.16.8. Pumps.

Sec. 102.2.17. "Q" Words.

Sec. 102.2.17.1. Quasi-Public Supply.

Sec. 102.2.18. "R" Words.

Sec. 102.2.18.1. Rear Inlet Spud.

Sec. 102.2.18.2. Rim.

Sec. 102.2.19. "S" Words.

Sec. 102.2.19.1. Sanitary Plumbing.

Sec. 102.2.19.2. Secondary Supply.
Sec. 102.2.19.3. Sewer Flushing Tank.
Sec. 102.2.19.4. Side Inlet Spud.
Sec. 102.2.19.5. Siphon Preventer.
Sec. 102.2.19.6. Soil Pipe.
Sec. 102.2.19.7. Sterilizer.
Sec. 102.2.19.8. Submerged Inlet.
Sec. 102.2.19.9. Swing Connection.
Sec. 102.2.20. "T" Words.
Sec. 102.2.20.1. Tank.
Sec. 102.2.20.2. Tap.
Sec. 102.2.20.3. Top.
Sec. 102.2.20.4. Trap.
Sec. 102.2.21. "U" Words.
Sec. 102.2.21.1. Used Water Supply.
Sec. 102.2.22. "V" Words.
Sec. 102.2.22.1. Vacuum.
Sec. 102.2.22.2. Vaccum Breaker.
Sec. 102.2.22.3. Vat.
Sec. 102.2.22.4. Vent.
Sec. 102.2.22.5. Vent Pipe.
Sec. 102.2.23. "W" Words.
Sec. 102.2.23.1. Waste.
Sec. 102.2.23.2. Waste Line.
Sec. 102.2.23.3. Waste Pipe.
Sec. 102.2.23.4. Water Ejector.
Sec. 102.2.23.5. Water Fixture.[10]
Sec. 102.2.23.6. Water Pipe.[11]
Sec. 102.2.23.7. Water Priming Pump.
Sec. 102.2.23.8. Water Rules and Regulations.
Sec. 102.2.23.9. Water Service.
Sec. 102.2.23.10. Water Service Requirements.[12]
Sec. 102.2.24. "X," "Y" and "Z" Words.

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[10] Attention of the reader is called to the definition of "Plumbing Fixture" (Sec. 102.2.16.5, *supra*) wherein a "Water Fixture" is encompassed by the definition last mentioned.

[11] As in the case of a "Water Fixture," "Water Pipe" is included within the definition of "Plumbing" (Sec. 102.2.16.4, *supra*).

[12] This matter has previously been discussed in connection with the "General Provisions" of the Ordinance (Sec. 101.4.21, *supra*).

Chapter Third—Permits[13]

Sec. 103.1. In General

Sec. 103.2 To Whom Issued

Sec. 103.2.1. In General.
Sec. 103.2.2. Public Bodies.
Sec. 103.2.3. Purposes for Which Issued.
Sec. 103.2.4. Property Covered by Permit.
Sec. 103.2.5. Work Covered by Permit.
Sec. 103.2.6. Application for Permit.
Sec. 103.2.6.1. Drawings, Specifications, etc.
Sec. 103.2.6.2. Approval by Inspector.
Sec. 103.2.6.3. Form of Application.
Sec. 103.2.6.4. Contents of Application.
Sec. 103.2.6.5. Affidavit—Certificate of Master Plumber.
Sec. 103.2.6.6. No Work by Unlicensed Plumber.
Sec. 103.2.7. Issuance of Permit.
Sec. 103.2.8. Notice and/or Hearing Upon Denial and/or Modification of Permit.
Sec. 103.2.9. Permit Required—When.
Sec. 103.2.9.1. Construction.
Sec. 103.2.9.2. Alteration and/or Repeal.
Sec. 103.2.9.3. Maintenance and/or Use.
Sec. 103.2.10. Fees and Charges.
Sec. 103.2.11. Exceptions.
Sec. 103.2.12. Exceptions.
Sec. 103.2.12.1. Public Bodies.

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[13] As in the case of "Definitions," the writer has not attempted to set forth specific provisions with respect to "Permits." It might be well, however, to point out that the "Permits" herein referred to are not precisely identical with those which are normally issued by departments of health and/or building and safety. Although the "Permits" here referred to would be designed to protect the water supply by requiring inspection of, and the use and operation of, "approved" plumbing and water fixtures, piping equipment, etc., there is an additional feature, namely, the requirement of a "permit" as a condition precedent to the "delivery and supply" of potable water for domestic purposes. This will undoubtedly involve the promulgation and adoption of *forms of contracts* which would incorporate, in the provisions thereof, agreements by the consumer to comply with the provisions of the Article in question and to remove, and/or refrain from the installation and/or use of, cross-connections or other installations which might admit of the occurrence of back-siphonage and/or back-flow.

Sec. 103.2.12.2. Public Works, Including Water Service.
Sec. 103.2.13. Permit Covers Only Work Mentioned.
Sec. 103.2.14. No Work Other Than That Mentioned.
Sec. 103.2.15. No Person Other Than That Mentioned.
Sec. 103.2.16. Expiration of Permit.
Sec. 103.2.17. Revocation of Permit.
Sec. 103.2.17.1. "Stop Order" in Writing.
Sec. 103.2.17.2. No Further Work Until Compliance.
Sec. 103.2.18. Inspection Required.
Sec. 103.2.19. Inspection Notice.
Sec. 103.2.19.1. Types and Methods of Inspection.
Sec. 103.2.19.2. Types and Methods of Tests.
Sec. 103.2.20. Authority to Enter Buildings—Inspection and/or Enforcement.
Sec. 103.2.21. Construction Under Permit—Workman-like Manner, Good Engineering Practice.

Chapter Fourth—Department, Board, and Division of Sanitary Engineering Duties, Powers and Orders[14]

Sec. 104.1. Duties of Department

Sec. 104.1.1. Testing Devices. The —— Department shall be charged with the testing of water piping pressures, water devices and plumbing fixtures under such rules and regulations as may from time to time be adopted by said Department. Such testing shall include the installation of pressure- and vaccum-recording gages on private piping systems, with all water services in the reasonable maximum use, in order to test the adequacy of any such private water distribution system. Water devices and plumbing fixtures shall be tested by approved methods under specifications established by said Department, which testing shall include setting up the fixtures with a water supply and a vacuum source so that observations can be made under all phases of back-flow and back-siphonage conditions, and by a "long time" or an "accelerated" test to determine

[14] This chapter is given over to provisions relative to the duties, powers and/or orders of the department, board and/or division of sanitary engineering charged with the protection of the domestic water supply. These "duties" should be specific and comprehensive. The "power" should be broad and elastic and the "orders" should be designed to effect an immediate compliance with laws, rules, regulations and/or water service requirements and a sweeping elimination of all installations or contemplated installations which violate such provisions.

durability and reliability of moving and operating parts against corrosion, deposition and re-action of materials passing the device.

Sec. 104.1.2. Setting-Up of Laboratory. Said Department shall set up separately and/or in conjunction with other interested Departments co-operatively joint test, research, chemical and bacteriological laboratories for the purpose of effectively controlling cross-connections, inter-connections, back-flow and back-siphonage.

Sec. 104.1.2.1. Approved Fixture. Wherever herein the expression "approved type of fixture" is used, the same shall refer to such fixture or fixtures as may from time to time be approved by the aforementioned laboratory or, in the absence of such approval, shall be such fixture as shall have been approved by a nationally recognized testing laboratory.

Sec. 104.1.3. Division of Sanitary Engineering. Said Department shall maintain a Division of Sanitary Engineering which shall have charge of such matters and shall have such powers as may be referred and delegated to it by said Department in connection with its powers and duties under this Article.

Sec. 104.1.4. Chief Engineer of Division. Said Department shall appoint a Chief Engineer of said Division of Sanitary Engineering who shall be a graduate sanitary engineer.

Sec. 104.1.5. Water Piping Code. Said Department shall adopt an adequate standard water piping code which shall cover: (1) the use of proposed services for homes, apartments, public buildings, food preparation and eating places, hotels, commercial establishments and industrial plants; (2) the determination, from time to time, of the maximum quantity of water required by any service, by totaling the capacities of all fixtures used and assuming that a reasonable percentage thereof would be used simultaneously; (3) the taking into account of the elevations and lengths of service lines; (4) the arrival at a determination of the size of meter and size of service and branch lines which will not result in a pressure drop (including that at the meter or at any fixtures) exceeding ten (10) pounds per square inch; and (5) the use of risers and storage tanks to reduce pressure variations to a minimum.

Sec. 104.1.6. System of Paint Code. Said Department shall adopt a general standard scheme of paint colors (i.e. a "color code") for water waste vents or sewer lines to prevent the unintentional making of direct connections.

Sec. 104.1.7. Pipe for Mains and Services. Said Department shall select, for use in the installation of street mains and/or of services, its pipes according to the character of soil in which they are to be used. The use of "second-hand pipe" is prohibited, and the installation and construction thereof, and the type and nature of the drainage to be used shall be such as, from time to time, may be specified in said water service requirements.

Sec. 104.1.8. Drainage for Repairs—Shut-Off. Said Department shall, after reasonable notice, shut off every house service to be, or which might be, affected when the mains of said Department are to be purposely drained for repairs.

Sec. 104.1.9. Water Surveys. Said Department shall, from time to time, conduct plumbing and water supply surveys which shall include the inspection of schools, theatres, residences, and such other types of buildings and improvements as may be set forth in said water service requirements.

Sec. 104.1.10. Manuals and Data. Said Department shall, from time to time, prepare and make available to its inspectors and to the public generally, manuals, data, and information relative to the installation, operation, maintenance and control of water supplies and water and plumbing, pipes and fixtures.

Sec. 104.2. Duties of Board

Sec. 104.2.1. Report to Council. Said Board shall, at each regular session of the City Council, make a report with such suggestions as to legislative action as said Board deems proper.

Sec. 104.3. Powers of Board

Sec. 104.3.1. Adoption of Rules and Regulations. The Board is hereby empowered to adopt such rules and regulations, consistent with the provisions of this Article, as may be necessary for the enforcement hereof.

Sec. 104.3.2. Commence and Maintain Actions. The Board of —— may commence and maintain all proper and necessary actions and proceedings for any or all of the following purposes:

Sec. 104.3.2.1. Enforce Rules. Enforce the rules and regulations of said Department.

Sec. 104.3.2.2. Enjoin Nuisances. Enjoin and abate nuisances dangerous to public health.

Sec. 104.3.2.3. Compel Performance of Acts. Compel the per-

formance of any act specifically enjoined upon any person, officer, or said Board, by this Article, or by any law of this State, relating to the public health.

Sec. 104.3.2.4. Protect and Preserve Public Health. Protect and preserve the public health.

Sec. 104.3.3. Defend All Actions. The Board may defend all actions and proceedings involving its powers and duties. In all actions and proceedings it shall sue and be sued under the name of said Department.

Sec. 104.4. Orders of Board

Sec. 104.4.1. Making of Orders. Said Board shall, from time to time, promulgate and enforce such orders, relative to the administration and/or enforcement of this Article, as may be necessary or convenient.

Sec. 104.4.2. No Person Shall Fail to Comply With Order. No person shall fail, refuse or neglect to comply promptly with any order, notice or direction of the Board issued in accordance with the provisions of this Chapter or the health laws of this State.

Sec. 104.4.3. No Person Shall Fail to Comply With Rules and Regulations. No person shall fail, refuse or neglect to comply with all the rules and regulations adopted by the Board pursuant to the provisions of this Chapter.

Sec. 104.5. Duties of Chief Sanitary Engineer

Sec. 104.5.1. Enforce Order of Board. Said Chief Sanitary Engineer shall enforce all orders and regulations of said Board; shall vigilantly enforce sanitary conditions throughout said City; and shall take all necessary precautions to protect said City in its relations with other cities and counties, insofar as health and sanitation are concerned.

Sec. 104.5.2. Record and Report to Board. Said Chief Sanitary Engineer shall keep, or cause to be kept, an accurate record of the acts and proceedings of said Department pursuant to this Article, and shall file a written report thereof to said Board at each regular meeting thereof.

Sec. 104.5.3. Assist Department in Enforcing. Said Chief Sanitary Engineer shall assist said Department in the enforcement of: (1) all ordinances and resolutions of the City Council pertaining to the public health and sanitation; (2) all orders, rules and regulations prescribed by the State Department of Public Health; and (3) all statute and code provisions of the State relating to public health.

Sec. 104.5.4. Report to State Department of Health. Said Chief Sanitary Engineer shall report to the State Department of Health all violations of the state health laws that come to his attention.

Chapter Fifth—Service Conditions and Discontinuance[15]

Sec. 105.1. Minimum Requirements

In connection with the delivery and service, by said Department, of the domestic water supply to the inhabitants of said City, said Department shall adopt minimum requirements for such delivery, service and supply, which requirements shall not be less rigid than those specified by the United States Department of Commerce, including all provisions with respect to plumbing and water piping and cross-connections.

Sec. 105.2. Right to Make Inspections

Employees of said Department shall have free access at proper hours of the day to all parts of all buildings and premises receiving from said Department, or otherwise, a potable domestic water supply, for the purpose of inspecting the conditions of the pipes and fixtures therein and/or the manner in, and the purposes for, which such water is being used and to do any and all acts or things necessary or convenient to carry into effect the provisions of this Article.

Sec. 105.3. Contracts and Permits Subject to Cancellation

All contracts and permits for water supply service shall be subject to cancellation, at the option of said Department, and service thereunder may be discontinued, for: (1) the installation on any premises of any fixtures or connections without (a) having the same made by a licensed plumber, and (b) making the required reports thereof to the office of said Department; and/or (2) the installation of plumbing fixtures which are not satisfactory to said Department and which are not in accordance with the rules, regulations and/or orders thereof.

Sec. 105.4. Discontinuance of Service

The recital of specific instances in this Article, wherein said Department is authorized to discontinue service, is not to be construed

[15] The provisions of this chapter, more or less, speak for themselves. The "high-lights" might be said to be (1) the right of department inspectors to make necessary inspections; (2) the right of the department to discontinue service upon the failure of the consumer, within a reasonable time, to comply with any and all reasonable and pertinent laws, ordinances, rules, regulations, water service requirements, and/or orders; and (3) the control of conditions of service at the time of the granting by the department of a permit for service and the making of a service connection to the mains of said city.

as limiting the authority of said Department to the instances so specified. To the contrary, the said Department shall have the general right to discontinue service to any person for the latter's failure of compliance with, or violation or infraction of, this Article, or any amendments or additions thereto, which may then be in force; provided that said Department shall give such person a reasonable notice so to comply and/or to desist from such violation or infraction, and a reasonable opportunity thereafter within which to comply with such notice; provided, however, that no such notice need be given where the noncompliance with, or violation or infraction of, this Article results, or is likely to result, in a dangerous or unsanitary condition in the water system of said Department, or elsewhere, or where discontinuance of service is necessary to protect said Department from fraud, imposition, loss or abuse.

Sec. 105.5. Remedy Not Exclusive

The remedies heretofore provided in this Chapter shall in no wise limit or interfere with the enforcement of any remedies and/or penalties provided for elsewhere in this Article, but all such remedies shall be cumulative of, and in addition to, such other remedies and penalties.

Sec. 105.6. Control of Service at Time of Issuance of Permit

Sec. 105.6.1. No Service Where Other Supply Without Agreement. No water service from, or any connection with, the water supply system of said City will be granted to the owner of any premises supplied with water from any other source for use on or about said premises; *provided, however,* that, if said owner of said premises so supplied shall enter into an agreement, binding on himself and his successors in interest, whereby such owner covenants not to make any cross-connection, or permit one to be made, between the water supply system of said City and any other water supply or system for, or upon, such property, and shall either (1) pay the scheduled rate for such premises (without deduction for any benefit derived from any outside source of supply) or (2) install a meter for such premises under the rules and regulations of said Department and pay for water at the scheduled meter rates, a service or connection shall be granted to such premises under said rules and regulations.

Sec. 105.6.2. Form of Agreement. The agreement, hereinbefore, in Sec. 105.6.1, referred to, shall be substantially in words and figures as follows, to wit:

"WHEREAS, The making of any water service connection by and between the mains of the party of the first part and the service pipes of any premises supplied with water from any other source is in violation of the rules and regulations of the party of the first part, unless, and until, an agreement, substantially in the form of the within agreement, be entered into by and between said party of the first part and the party of the second part as owner or occupant of the premises so supplied; now, therefore, be it *Understood and Agreed* That the party of the second part, and/or his successors in interest and/or assigns, will not cross-connect the water supply from the secondary source of supply on his premises, or from any other source, to any pipe, faucet or other device whereby water from such secondary source of supply or such other source might, in any manner whatsoever, be introduced into the mains of the party of the first part, and will not allow any such cross-connection to exist and/or to be installed by any other person or persons in, or upon, the above described premises contrary to, and/or except in compliance with, any and all applicable rules and regulations of said party of the first part.',

Sec. 105.7. Statement re: Absence of Cross-Connections

Any person, firm or corporation whose premises are supplied with water from the water supply system of said City, and who also has on the same premises a separate source of water supply or stored water, whether in pools, storage tanks, standpipes, containers, or otherwise, from which the water therein stored is circulated through the piping system on said premises, shall file with said Department a statement of the non-existence of cross-connections between said secondary source of supply and the water supply system of said City.

Sec. 105.7.1. Form of Statement. The declaration of the non-existence of cross-connections, provided for in Sec. 105.7 hereof, shall be upon a form supplied by said Department, which form shall be substantially in words and figures as follows, to wit:

CONSUMER'S DECLARATION OF NON-EXISTENCE OF CROSS-CONNECTIONS

Pursuant to the provisions of The Municipal Code of the City of Modern City, and of the rules and regulations of, and affecting the service of water by, the Department of ——, (we, I) do hereby declare that no cross-connections whatsoever exist, upon the premises located at —— and more particularly described as follows, to wit:

(*Insert description*)

between the water supply system of said City and any other source or sources of supply upon said premises such as is, or are, prohibited by the provisions of said Municipal Code, and that (we are, I am) the (owner, occupant) of said premises.

(We, I) further acknowledge receipt of copies of Article No. —— of said Municipal Code relating to cross-connections, and the rules and regulations of said Department adopted pursuant thereto, and do hereby agree not to permit any such cross-connection, or cross-connections, to be installed and/or to exist upon said premises.

(We, I) further certify that there is no private water supply, or any water stored, or any provision by which water may be retained in storage, on said premises and that there is no cesspool or equipment for the pumping of sewage thereon except as follows:

(*Insert description*)

Chapter Sixth—Elimination and/or Control of Cross-Connections, Inter-Connections, Back-Flow and Back-Siphonage[16]

(*A. Prohibited Connections, Fixtures, Equipment and Devices*)

Sec. 106.1. Dual Supply Connections

Sec. 106.1.1. None to Be Made. After the —— day of ——, 19—, no new connections shall be made between a safe water system and any unsafe, unapproved or unauthorized supply, public or private.

Sec. 106.1.2. Present Connection to Be Protected. Where the prohibited connections are in existence at the effective date hereof, the same shall be permitted to continue in existence, provided that, within a period of —— days from and after said effective date the owner or occupant of the premises upon which such connections exist, shall use and/or provide and install, in conjunction with said connection, such approved methods and/or devices for the protection of the domestic water supply of said City as shall be prescribed by said Department.

[16] This chapter covers "prohibited" connections, and other connections, piping and fixtures. There have, however (and perhaps erroneously so), been included within said chapter some provisions for mechanical or other devices designed to control back-siphonage and back-flow conditions in existing situations and to permit of a few connections (otherwise prohibited) under special conditions.

Sec. 106.1.3. Temporary Installation. Temporary installations of sewer and other similar connections may be made during emergencies, provided such emergencies are reported to representatives of said Department and approval thereof obtained.

Sec. 106.1.4. Present Double Check Valve Installations. Wherever, prior to the effective date hereof, double check valve installations have been approved, if, on thirty-day inspections by representatives of said Department, any of such installations are found to be faulty, the same shall be removed unless, within a period of —— days, an installation meeting the approval of said Department shall have been made.

Sec. 106.1.5. Color Code—Dual Supply Piping. In every instance where dual supplies exist, all exposed piping carrying city water shall be uniformly painted a distinguishing bright blue color and shall be so maintained that each pipe may be readily traced in its entirety by such color. In instances where the bright blue color conflicts with already well established systems of painting in a particular plant, said Department may allow the use of another color of equal brightness and distinction. Detailed plans of all underground or unexposed piping, both for the city supply and for the secondary supply, shall be furnished to said Department and corrections made thereto if, and as soon as, any such alterations are made.

Sec. 106.1.6. No Connection to Be Made or to Exist. No person shall, in any manner make any connection, or allow one to exist, for any purpose whatsoever, between pipes or conduits carrying water supplied by said City and any pipes, conduits or fixtures carrying water from any other source or carrying water which has been used for any purposes whatsoever after having left any mains, pipes or conduits under the control of said Department.

Sec. 106.1.7. Combination Faucets. Combination faucets having another supply, such as hot water, in addition to the city water supply, are included within the prohibition hereof and provision for a removal nipple in a new installation will be considered a physical connection prohibited under the terms hereof and such installations shall be done only with written permission of said Department and then only in case of emergency, and the nipple shall not be left in place longer than the period of the emergency.

Sec. 106.1.8. Independent Pipes and/or System. The water supply of said City shall be distributed through a system of piping entirely independent of any other piping and/or system conveying another

water supply, or of any piping or device conveying any other thing whatsoever.

Sec. 106.2. Connections to Sewers, Waste Pipes, etc.

Sec. 106.2.1. Direct Water Service to Flush Valves and Sewer Lines. Direct water service to flush tanks and sewer lines is expressly prohibited.

Sec. 106.2.2. No Connection—Distribution System and Drainage System, etc. No connection shall be permitted between a distribution system or water supply for drinking and domestic purposes and any drainage system, closed or other sewer system, or any soil or waste pipe so as to permit or make possible the back-flow or back-siphonage of sewage and/or waste, and/or any other matter and/or thing into the water supply system.

Sec. 106.2.2.1. No Plumbing Device—Licensed Plumber Held Responsible. No plumbing device, fixture, valve, fitting, apparatus, or plumbing connection of any kind that will provide a connection between a potable water supply and any sewerage system, or will permit or make possible, by siphonage or back-flow, the introduction of sewage or waste into the water system, shall be installed. Licensed plumbers will be held responsible for the observance of this rule and any violation thereof will subject the offender to the suspension or revocation of his license.

Sec. 106.2.2.2. Tank Overflows to Sewer. No: (1) water pipes from refrigerator systems, overflows and water tanks, from which water is taken for drinking and cooking purposes; (2) pipes from water supply tanks, cisterns, expansion tanks and drip pans; (3) exhaust from a water lift; (4) hose, tube or pipe connected to any hot and/or cold water piping; (5) hot and/or cold water piping or any portion thereof, shall be connected with any house drain, soil, waste or drain pipes and/or any trap, tail-piece drain piping, waste piping, soil piping, house drainage system, sewer or any portion thereof, but any and all discharge therefrom shall be into an open fixture, properly trapped and vented, provided for that purpose, said discharge pipe outlet to be at least —— ( ) inches above the overflow line of such fixture.

Sec. 106.2.2.3. Overflow—Hot Water Heating Systems. The overflow pipe or outlet from hot water heating systems may be carried to the outside of the building so as to discharge freely into the open air.

Sec. 106.2.2.4. Hydraulic Lifts, Elevators, etc. Discharges from hydraulic lifts, elevators and all other hydraulically operated equipment, air compressors, motors, sewer ejectors, pumps, elevators, presses and fountains and from air-conditioning equipment, that connect to the City sewer system, shall empty into open fixtures so that there will be no possibility of back-flow or back-siphonage of sewage into the domestic water supply.

Sec. 106.2.2.5. Air-Conditioning Equipment. Air-conditioning equipment provided with a City water supply and waste pipes draining condensers shall not be directly connected to sewer pipes.

Sec. 106.2.2.6. Manually Operated Sewer Connections. All frost-proof closets (where supply valves waste into a soil pipe, waste pipe or sewer) shall be a flush-rim with an oval straight hopper and shall be flushed from a tank. The valve shall be self-draining to a point below frost. The water supply shall be protected against "water hammer" by an approved shock absorber and against siphonage by an open drain waste. The drain waste from the valve shall be led to a dry well containing at least one cubic yard of broken stone or gravel and located not less than ten (10) feet from the wall of any building.

Sec. 106.2.3. Submerged Inlets, etc. Except as in this Article otherwise provided, submerged inlets or sewer connected fixtures shall be prohibited.

Sec. 106.3. Pumps, Pump Priming Lines, etc.

Sec. 106.3.1. Pumps and Pressure-Producing Devices Prohibited. No pump and/or pressure-producing device and/or hydraulic elevator, lift and/or press shall be supplied from the water supply lines of said City except through an intervening tank or other equipment approved by said Department as provided in Chapter Eighth hereof.

Sec. 106.3.2. Pump Priming Lines. Except as hereinafter in this Chapter provided, under no circumstance nor condition will a direct connection between the water supply of said City and a pump installed and operated for the purpose of pumping any liquid of any character whatever be permitted. The above shall apply to boiler feed water pumps, circulating pumps of all kinds, sewerage pumps, basement bilge pumps, and pumps for all purposes whatsoever, excepting those used for the purpose of re-lifting water from the City's mains into auxiliary supply tanks which supply water for sprinkler, circulating ice water, hot water heating, air-conditioning,

and like, systems. In the latter case the outlet of the supply line from the pump to the tank must be installed in such a way that the said supply line will go over the top edge of the tank and shall discharge into the tank from the top, and the outlet end of the discharge line shall be at least six (6) inches above the elevation of the overflow of the tank. In all cases and conditions not covered by this Chapter, a duly authorized representative of said Department shall determine whether or not a given condition is unsanitary, a source of contamination, or a hazard to the public health and safety.

Sec. 106.3.3. Pumped Domestic Water Supply. Water supply connections for priming purposes to sump, well or similar type pumps involving only domestic water shall be connected to the inlet side of the pump and be equipped with an approved vacuum breaker and check valve, the check valve to be located between the pump and the vacuum breaker. All other such connections are prohibited.

Sec. 106.3.4. Water Lines to Hydraulic Elevators, etc. The operation of hydraulic elevators by direct pressure provided by the use of water from the water supply system of said City is expressly prohibited, and the exhaust from a water lift shall not be directly connected with any house drain, soil or waste pipe, but shall discharge upon the roof or be dripped into an open fixture or discharged as is herein provided for refrigerator wastes. Under special conditions, and with the consent of said Department, such pipes may be connected to a drain leader.

Sec. 106.4. Boiler Connections and Vacuums

Sec. 106.4.1. Boilers, Vacuum Equipment, etc., Prohibited. The following direct connections to the water domestic system are hereby expressly prohibited: (1) vacuum pumps; (2) vacuum cleaning devices or systems; (3) steam generating units; (4) high and low pressure boilers; and (5) hot water heater and hot water storage tanks.

Sec. 106.4.1.1. Filling of Boilers. Boilers may be filled by gravity feed tanks with air gap water line inlets, float-operated tanks with pumps, steam injectors and/or hand pumps.

Sec. 106.4.1.2. Mechanical Relief of Pressure. Subject to the approval of, and in those cases prescribed by, said Department, said boiler connections may be protected by mechanical devices which will relieve at pressures higher than domestic water pressure, will provide a broken connection to atmosphere when not in use, and will provide a satisfactory vacuum on the domestic air lines.

Sec. 106.4.2. Installation of Vacuum Systems. Drinking water, vacuum cleaning, and yard sprinkler systems and fire standpipe lines are to be installed by licensed and registered plumbers.

Sec. 106.4.3. Aspirators—How Pressure Is Obtained. Pressure furnished by the water supply system of said City shall not be used to operate water ejectors for aspirators on surgical, dental or industrial equipment. Pressure may be obtained by discharging such water through a broken connection to a receiving tank from which said water may be drawn by means of a small pump and furnished to the fixture or ejector.

Sec. 106.5. Fixtures Generally

Sec. 106.5.1. Fire Service—No Physical Connection. No physical connection will be permitted between the water supply of said City and any industrial, fire, or other auxiliary or emergency water supply, whether potable or non-potable. This prohibition applies to all piping systems either inside or outside of any building or buildings, and no auxiliary or secondary suction pipe to any underwriter's pump taking water from any private source will be permitted.

Sec. 106.5.1.1. Fire Service—Water From Source Other Than City Water. Where water from another source is desired for additional fire protection it may only be used as hereinafter provided:

(1) An elevated tank may be supplied by a connection from the mains of said City at a point above the overflow in said tank. The tank may then be connected to the sprinkler, or other, pipes or system for use in fire protection; or

(2) A concrete reservoir may be constructed to which the mains of said City may be connected and pumps shall be provided to pump water from this reservoir to an elevated tank or standpipe for such purpose.

Sec. 106.5.2. Refrigerating and Air-Conditioning Equipment. The water supply for all mechanically or electrically operated systems and/or pumps in or by which water is circulated for the purpose of supplying or extracting heat, such as air-conditioning systems, cooling towers, heating systems in which water is circulated by means of pumps or other similar equipment, and any and all systems whatsoever where, in the judgment or opinion of said Department, water may be subject to contaminating influences, shall be connected directly to the water supply system of said City, but shall be supplied

with water taken from a tank which is in no way so connected. Said tank must be supplied by a pipe from said system controlled by a manually or automatically operated valve, said pipe to be installed over the top edge of the tank with an one hundred and eighty (180) degree return bend, the outlet to be at least six (6) inches above the elevation of the overflow line or outlet of said tank.

Sec. 106.5.3. Ammonia Tank—No Discharge to Sewer. Emergency emptying pipes, from the ammonia tank of any cold storage or refrigerating system, shall not be connected to any house drain or house sewer, or to any part of a plumbing or drainage system.

Sec. 106.5.3.1. Ammonia Tanks for Discharge From Cooling System, etc. The ammonia, discharged from refrigerating, cooling and other systems, shall be so discharged into a tank containing sulfuric acid of sufficient quantity to neutralize said ammonia. Such tanks shall be securely covered and shall have a relief pipe not less than three (3) inches in diameter extending to the outer air.

Sec. 106.5.3.2. Plans for Method Other Than Tank. The plans for any system or any type apparatus intended to neutralize ammonia, other than that referred to in Sec. 106.5.3.1 hereof, must be submitted to said Department for inspection and investigation and, if accepted, the former may be used in lieu of the latter.

Sec. 106.5.4. Toilets and Toilet Fixtures.

Sec. 106.5.4.1. Flushometer Type Siphon Jet Toilets. Flushometer type siphon jet toilets without vacuum breakers are hereby prohibited.

Sec. 106.5.4.2. Side Inlet Bowls. The installation and/or use of side inlet bowls are hereby expressly prohibited.

Sec. 106.5.4.3. Water Closet, Urinal, etc. No water closet, urinal, or any other fixture, appliance, appurtenance, or device shall be directly supplied from a water distribution system through a flushometer, or other valve, faucet, bibb, or device, unless such valve, faucet, bibb or device, and outlet therefrom is set above the extreme overflow rim of the water closet, urinal, fixture, appliance, appurtenance, or device, in such a manner, or of such construction, as to prevent any possibility of polluting or contaminating the water supply, either by gravity flow, siphonage, back-pressure, or by any means whatsoever.

Sec. 106.6. Addition of Chemicals

Sec. 106.6.1. Poisonous Chemicals Prohibited. No poisonous chemicals shall be added to water supplied by said City.

Sec. 106.6.2. Non-Poisonous Chemicals Regulated. Non-poisonous chemicals may be added only pursuant to the provisions of this Article and only by licensed plumbers and/or employees. The devices used to admit such non-poisonous chemicals shall first have been approved by said Department.

Sec. 106.6.3. Main Treatment Plants for City. Main treatment plants for the entire City shall use only such chemicals as are recommended by, and such use shall be under the direct supervision of, said Department.

Sec. 106.6.4. Corrosion Control. The addition, to hot water systems which may be used for drinking purposes, of metallic silicates and silicates for corrosion control containing phenolphthalein or other purging constituents which are poisonous, is hereby expressly prohibited.

Sec. 106.6.4.1. Corrosion Control—Hotels, Apartment Houses and/or Office Buildings. Any and all hotels, apartment houses and/or office buildings using sodium silicates for corrosion control shall post notices in prominent places at, or near, all taps receiving such water as so containing said silicates, which notices shall advise persons not to drink such water.

Sec. 106.6.5. Softening of Water—Hotels, Apartment Houses and/or Office Buildings. Any, and all, hotels, apartment houses, office buildings, softening water to zero hardness, should be required to mix treated water with untreated water to obtain a residual hardness of not less than five (5) parts per million.

Sec. 106.7. Miscellaneous Provisions

Sec. 106.7.1. No Person to Install Prohibited Connection. No person shall install or make, or cause or permit to be installed or made, any connection which is or may be a cross-connection and/or which is not protected against back-flow or back-siphonage as provided for, and/or which is prohibited, by this Article.

Sec. 106.7.2. No Person to Maintain and/or Use Prohibited Connection. No person shall maintain and/or use and/or permit to be maintained and/or used, after the effective date hereof, any connection referred to in Sec. 106.7.1 hereof.

Sec. 106.7.3. Storage, House Supply and Other Tanks.

Sec. 106.7.3.1. House Supply Tanks to Be Covered. House supply tanks must be covered so as to exclude dust, and must be so located as to prevent the water from being contaminated by gas and odors from plumbing fixtures.

Sec. 106.7.3.2. Satisfactory Storage Tanks. It shall be unlawful to maintain storage tanks supplied only with City water, unless the tanks are satisfactorily built and are covered so as to prevent the entrance of contamination. All such tanks shall be subject to periodical inspection by said Department and shall be maintained in a manner wholly satisfactory to the standards and requirements of said Department.

Sec. 106.7.3.3. Supply Line to Tank—How Protected. Any City supply line discharging into improperly constructed and uncovered pools, reservoirs, storage tanks, standpipes, or insanitary containers of any kind in which the water therein stored is subjected to contamination must so discharge in such a manner as to prevent the siphoning back of the water, therein stored, into said City supply line due to the development of a negative pressure in such City supply line.

Sec. 106.7.3.4. Supply Line to Auxiliary Tank—How Protected. Any supply line from the mains of said City or from any booster pump taking water from said mains to an auxiliary supply tank for any purpose whatsoever shall be installed in such a way that the said supply line shall go over the top edge of the tank with an one hundred and eighty (180) degree return bend, the discharge end to terminate at least six (6) inches above the over-flow line or outlet of the tank. Under no circumstance nor condition shall any supply line to an auxiliary tank discharge through the bottom or side of said tank.

Sec. 106.7.3.5. Stand-By Supply—How Protected. Where a stand-by water supply has been, or is to be, installed, pipes carrying water from the potable water supply shall be protected against contact with water from the non-potable water supply by an atmospheric gap of not less than six (6) inches. This may be accomplished through an elevated tank with, or without, a booster pump or by a cistern with a booster pump. In every such case the inlet to the tank or cistern from the line carrying water from the potable supply shall discharge at least six (6) inches above the maximum possible high water level of the tank or cistern.

Sec. 106.7.4. Water Lines Through Sewer Manholes. Water lines shall not be located in, or be installed through, sewer manholes.

Sec. 106.7.5. Use of Gate Valves. Gate valves shall be installed in lieu of globe valves on all plumbing and water connections.

Sec. 106.7.6. Sewer Lines Over Water Tanks. All water tanks installed in, near or above buildings for the purpose of furnishing a supply of water which is intended to be used for domestic purposes shall be covered in a thoroughly water-tight manner; said cover to be made of a durable and non-corrosive material. In no case shall such a tank be installed under any pipe carrying sewage, impure water of any kind, or domestic, commercial or industrial waste. In the event such a tank is installed in the basement of a building, it shall be elevated at least one (1) foot above the basement floor and a clear and unobstructed space at least two (2) feet wide must be maintained entirely around the tank. The construction of such tanks shall be accomplished in such a manner as to be proof against the entrance of any kind of vermin or insects whatsoever.

Sec. 106.7.7. Water and Sewer Lines in Same Trench. No water service pipe shall be laid in the same trench with a building drain or sewer pipe, nor shall a water pipe be closer to a sewer than —— ( ) feet at any point horizontally, unless such building drain or sewer pipe be cast-iron soil pipe packed with oakum or hemp and secured with pure lead not less than one (1) inch deep, well calked.

Chapter Seventh—Elimination and/or Control of Cross-Connections, Inter-Connections, Back-Flow and Back-Siphonage[17]

(*B. Protected Connections, Fixtures, Equipment and Devices*)

Sec. 107.1. Provision of Chapter Sixth Not Appropriate—When

The provisions of Chapter Sixth hereof shall not apply: (1) to any water discharging outlet, orifice or opening, provided the lowest portion thereof is elevated a distance, above the top or rim of any fixed receptacle, fixed tank, fixed equipment or plumbing fixture supplied thereby, equal to the least diameter of such water dis-

[17] This chapter is designed to provide for a protection against back-siphonage and/or back-flow in those situations where it is necessary or desirable to permit the installation and/or retention of connections, piping and equipment which, without such protection, might allow such back-siphonage and/or back-flow.

charging outlet, orifice or opening (but in no case less than one (1) inch); or (2) to any faucet, stop cock, valve, outlet or orifice, provided every water-discharging opening therefore is located at least six (6) inches above the floor, paving or surface directly underneath the same, and provided such faucet, stop cock, valve, outlet or orifice is not located in any room designed, intended or used for medical, therapeutic, dental, surgical, undertaking, mortuary, autopsy or similar purposes, and provided also that it does not supply water to any fixed tank, fixed receptacle, fixed equipment or plumbing fixture, and provided also, that such installation will not, in the judgment of said Department, result in a dangerous or insanitary condition; or (3) to outlets for lawn sprinkler systems which are provided with an approved type of check valve and vacuum breaker installed in a readily accessible place in that portion of the water piping supplying all outlets of each such system and installed at such a location and elevation that there will be no reasonable probability of such device being submerged by surface drainage or by any other cause. Said Department shall determine the proper location for the installation of each such device.

Sec. 107.2. Back-Flow and Back-Siphonage Protection Required—When

Every outlet, opening, orifice and/or termination of any hot and/or cold water piping (including every faucet, stop cock, ballcock, valve or similar appliance) through which water is discharged from any such water piping, and every cross-connection as defined in this Article, shall be protected against the possibility of back-flow and back-siphonage by means of one of the following means and/or methods, to wit: (1) an approved flush valve, together with an approved air inlet or vacuum breaker, complying with, and installed as required by, the provisions of this Chapter; or (2) an approved check valve and vacuum breaker complying with, and installed as required by, the provisions of this Chapter; or (3) any other approved device complying with, and installed as required by, the provisions of this Article.

Sec. 107.3. Submerged Water Supply Inlets to Be Protected

Every submerged water supply inlet to any fixture and/or appliance shall have a vent opening or air gap sufficient to break any vacuum therein and to prevent any back-flow and/or back-siphonage therethrough. In addition thereto, such fixture and/or appliance shall be protected: (1) as provided for in Sec. 107.2 hereof; and (2)

whenever mechanically possible when such action does not interfere with the functional operations of such fixture and/or appliance, any such inlet shall be raised not less than six (6) inches above the maximum high water level of said fixture and/or appliance.

Sec. 107.3.1. New Fixtures and/or Appliances to Be Protected. Any fixture and/or appliance, hereafter installed, shall be of a type provided with a raised inlet and, in addition thereto, shall be protected as provided in Sections 107.2 and 107.3 hereof.

Sec. 107.3.2. Protection Where Inlet Cannot Be Raised. If the water supply inlet cannot be raised above the maximum possible water level, an approved type of vacuum breaker must be installed between the control valve and the fixture in such manner that no back-flow and/or back-siphonage is possible under any degree of vacuum in the water lines and with water in the fixture at the maximum possible water level. For positive protection *each* such fixture must have a vacuum breaker.

Sec. 107.4. Approved Toilet Bowls

Only top inlet toilet bowls with stable flush valves shall be installed and/or used, and each such said fixture shall be equipped with a vacuum breaker between the flush valve and a point six (6) inches above the rim of said bowl. Said vacuum breaker shall be of a type and design approved by said Department.

Sec. 107.5. Storage Tanks for Toilets and/or Urinals (Groups or Batteries)

Every tank used for the storage of water for the flushing of a group or battery of toilets and/or urinals shall be a non-pressure tank and shall have the water supply inlet connected as provided in Sections 107.2 to 107.3.2, inclusive, hereof. The water supply pipe to the tank shall be equipped with both an automatic and manually operated shut-off valve and all such tanks shall have an overflow pipe which shall be carried to a point so as to spill over an open fixture or floor drain. The tank shall be so located and be of a size to give an equal and satisfactory flush to each fixture.

Sec. 107.5.1. Flush Tank Operated by Ball Cock to Be Protected. Every flush tank, operated by a ball cock, shall have an approved vacuum breaker located not less than —— ( ) inches above the overflow outlet of such flush tank.

Sec. 107.5.2. Integral Tank and Closet Bowl Combinations to Be Protected. Every integral tank and closet bowl combination, having

a discharge from a closet tank below the overflow rim of the bowl, shall have the water supply float valve equipped with an approved vacuum breaker not less than —— ( ) inches above the higher water level of such closet tank.

Sec. 107.6. Sufficient Flushing Supply for Fixtures

All plumbing fixtures shall be provided with a sufficient supply of water for flushing to keep them in a sanitary condition. Every water-closet or pedestal urinal shall be flushed by means of an approved tank or flush valve of sufficient flushing capacity and shall be adjusted to prevent the waste of water. The flush pipe for water-closet flush tanks shall not be less than 1½ inches in diameter, and the water from flush tanks shall be used for no other purpose.

Sec. 107.7. Automatically Closing Check Valve With Each Flush Valve

Every flush valve hereafter installed shall, in addition to the provision of an approved type of air inlet or vacuum breaker, as provided for in this Chapter, have installed therewith, in the water supply line thereof, an approved type of check valve, which is designed to close automatically whenever there occurs in such water supply line a reverse flow of any liquid or gaseous substance or of any mixture thereof; provided, however, that, whenever a flush valve with a stable piston or diaphragm is installed, only a manually operated shut-off valve shall be required in the water supply line to such flush valve.

Sec. 107.8. Provisions of Chapter Not Applicable—When

The provisions of this Chapter, relative to an air inlet or vacuum breaker for a flush valve, shall not apply to any fixture or receptacle to be flushed by a flush valve, provided such fixture or receptacle is equipped and provided with an approved type of air inlet or vacuum breaker which is a permanent and component part of such fixture or receptacle, and provided every such fixture or receptacle, or the type thereof, shall have been approved first by said Department as having an equivalent air inlet or vacuum breaker to that required by this Chapter for an approved type of flush valve, and provided, further, that in the judgment of said Department, such fixture or receptacle when installed will provide equivalent protection against back-flow and back-siphonage to that provided by an approved type of flush valve. Every such air intake or vacuum breaker for a fixture or receptacle shall have every portion of the air inlet therefor at least six (6) inches above the top of the rim of such fixture or receptacle.

The provisions of this Chapter shall not apply to any case where back-flow and/or back-siphonage protection is not required by the provisions hereof, nor in any case where protection against back-flow and/or back-siphonage is provided by one of the other methods or means specifically allowed by the provisions of this Chapter or of this Article.

Sec. 107.9. Water Supply Connections Generally

Water supply connections to (1) aspirators and water siphons and/or (2) baptistries, ornamental and lily pools, aquaria and ornamental fountain basins and/or (3) swimming pools, hospital sterilizers, toilets, urinals, bidets and/or (4) any and all other like fixtures, equipment, and/or appliances shall be made in a manner so as to make impossible the return, either by gravity, back-siphonage, back-flow, or any other method that would contaminate the water supply of any distributing system, of any of the liquid or waste from any of said fixtures, equipment and/or appliances to the water supply line of any distributing system furnishing such water supply. Said connections shall have the supplies thereto protected from back-siphonage, back-flow and/or gravity drainage by means of approved air-break or other devices placed on the supply side of such fixtures, equipment and/or appliances above the overflow level thereof; and all such water piping and water supply connections shall be regularly inspected by a duly authorized representative of said Department.

Sec. 107.9.1. Water Supply Connections to Bar, Soda Fountain and Other Sinks. The water supply to all sinks used in, at and/or for all bars, soda fountains and similar establishments shall discharge at a point at least three-quarters ($\frac{3}{4}$) of an inch above the rim of the fixture.

Sec. 107.10. Drinking Fountain Protection and Construction

The supply line to and for, drinking fountains shall be provided with an approved vacuum breaker; and such fixtures shall have an inclined jet with the orifice completely protected with a safety guard, and shall have the orifice not less than one-quarter ($\frac{1}{4}$) of an inch above the overflow rim.

Sec. 107.11. Basins and Fixtures With Flexible Hose Protection

Basins or other waste fixtures supplied with a flexible hose whose outlet may drop into the fixture below the rim of the fixture shall be equipped with a counterbalance or spring reel that will not permit the open end to remain below the rim of the fixture.

Chapter Eighth—Elimination and/or Control of Cross-Connections, Inter-Connections, Back-Flow and Back-Siphonage[18]

(*C. Protective Methods and/or Devices*)

Sec. 108.1. Mechanical Devices Which May Be Used

The mechanical and other devices for the control and/or prevention of back-flow and/or back-siphonage which may be used under, and pursuant to, the provisions of this Article shall (provided the same shall, prior to such use, have been approved as provided for in this Article and/or as prescribed and set forth in such "Water Service Requirements" promulgated pursuant hereto as shall, from time to time, be on file in the offices of said Department) include the following: (1) air relief valves; (2) stable flush valves with integral vacuum breakers; (3) vacuum breakers; (4) back-flow and back-siphonage valves, including pressure regulating and/or releasing devices; (5) swing connections; (6) inserted nipples; (7) double check valves with testing cocks, pressure gages, and shut-off valves; and/or air gaps.

The enumeration and/or specification herein of particular devices shall not be construed as preventing the use, and/or the prescription by said Department, of other and different devices if, and when, the same shall, by said Department, have been tested, as in this Article prescribed, and shall have been found, by said Department, to meet not less than the minimum requirements of safety, and of back-flow and/or back-siphonage control and/or prevention prescribed by this Article.

Sec. 108.2. Valves and Vacuum Breakers Subject to Tests and Approval

No flush valve, check valve and/or vacuum breaker, nor any tail piece with a vacuum breaker nor any other device required by this Chapter for protection against back-flow and/or back-siphonage shall be installed until the type and/or model thereof shall have first been subjected to, and shall have fully met and complied with, the tests provided therefore in this Chapter and shall have been approved by said Department.

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[18] This chapter is designed to set forth the types of, and specifications with respect to, mechanical devices for the control and/or prevention of back-flow and/or back-siphonage which should be required by the administrative bodies. These provisions are taken from the aforementioned appendix of the Goudey Paper and from recommendations made in that paper. It is submitted that they constitute a "minimum" standard to be followed if effective and complete protection is desired.

Sec. 108.2.1. Board Authorized to Prescribe Tests. Said Board is hereby granted the power and authority to adopt, and to establish by resolution in writing, test requirements for every such check valve, flush valve and vacuum breaker, tail piece with vacuum breaker, and/or any other device designed to protect against back-flow and/or back-siphonage, subject, in each case, to the limitations of, and provisions specified in, this Article. Such test requirements may, from time to time, be modified or revised by said Board, if, as, and when it shall deem such revision necessary.

Sec. 108.3. Check Valves Not Safety Device—Vacuum Breakers to Be Approved

Check valves, in and of themselves shall not constitute hereunder an approved safety device. Vacuum breakers shall be of an approved type, i.e., they must be approved by said Department and/or by a nationally recognized testing laboratory.

Sec. 108.4. Double Check Valve Installations—Pressure Relief

Every double check valve installation shall include a device to relieve and waste all water or other liquid or gaseous substance creating an excess pressure of five (5) pounds per square inch on the discharge (or private line or supply) side of the fixture and shall be equipped with an indicator to warn when any check valve on the same line leaks.

Sec. 108.5. Minimum Air Gap

The minimum required air gap between the orifice of a faucet and spill line of a fixture shall be as follows:

Basins	1 inch
Kitchen sinks and laundry trays	1½ inches
Bath tubs	2 inches

Sec. 108.5.1. Service Pipe Color—Air Gap Protection. In connection with air gap protection and/or protection by means of a tank with a raised inlet as provided in Chapter Seventh hereof, the service pipe from the meter to the tank shall be exposed and shall be painted a characteristic color. Said line shall be constructed of a metal different than that used in either the water or sewer lines in the same building and shall be encased in concrete.

Sec. 108.6. Valve Installation Inspection—Correction of Faults

All valve installations heretofore made, or hereafter made, pursuant to the terms hereof, shall be inspected at least once in every

calendar year, and any and all valves, which are subject to leaks or other faults, shall be corrected pursuant to orders of said Department and shall be inspected by said Department not less than twice within a period of three months from and after such installation to determine if an installation satisfactory to said Department has been made.

Sec. 108.7. Meters, Pipes and Fixtures to Comply with Department Code

Meters, pipes and/or fixtures used for, or in connection with, the supply of water for domestic, irrigation, industrial and/or commercial uses shall be of such a size and material, and shall be so installed, as to avoid, or minimize, drops in pressure, water losses in the piping system and/or fixtures and contamination of said water supply. Such meters, pipes and/or fixtures shall, insofar as possible, comply with, and shall be installed in conformity with, the code or standard from time to time adopted by said Department, copies of which, including specifications and data, shall be kept on file in the offices of said Department.

Sec. 108.8. Minimum Size of Meter

The minimum size of meter shall be three-quarters ($\frac{3}{4}$)* of an inch for ordinary uses and a larger size shall be required where flush valves are used.

Sec. 108.9. Special Waste Lines—Characteristic Color

All special waste lines shall be made of such material and shall be painted such a color as shall serve to distinguish them from other piping.

Sec. 108.10. Vacuum Breakers—Non-Corrosive—Specifications

All vacuum breakers: (1) shall be corrosion proof; (2) shall contain a minimum number of moving and/or movable parts, all of which function each time the flush or other valve operates; (3) shall not spit water; and (4) shall be designed to defeat ready "plugging" or mutilation.

Sec. 108.11. Mechanical Device Specifications

Sec. 108.11.1. Specifications of Chapter Sixth. Wherever the use of a mechanical device for the prevention of back-flow and/or back-siphonage is required under and pursuant to the provisions of Chapter Sixth hereof and/or is permitted by said Department under and pur-

* This requirement is debatable.—*Editor.*

suant to the provisions of this Article, said mechanical device shall be of a type approved by said Department and shall possess the following operating functions:

(1) A "port," equal in diameter to that of the connected pipe and so operated manually and/or automatically that a broken connection, at all times under back-flow and/or back-siphonage conditions, is provided.

(2) The prevention of back-flow and/or back-siphonage is normally accomplished by a check valve, the leakage, if any, of which can readily be seen by inspection.

(3) Any necessary repairs to such fixture can be made by shutting only two valves, said valves being located one each on the supply side and the discharge side, respectively, of said fixture.

(4) The relief of all "excess" pressure on the discharge (or private line or supply) side of said fixture (equal to, and/or in excess of, five (5) pounds per square inch or more) due to, and/or passing, and escaping by way of, a leak in a check valve, is provided by an approved device integrally constructed and which remains "seated" at all times under reverse flow and/or static conditions.

(5) All parts of any such "pressure releasing" device are independent of all ports and all parts thereof.

(6) A check is provided whereby, if, and when, a vacuum is produced on the supply (or City water system) side of said fixture, full action on the valve is prevented and air is admitted to destroy the residual effect of said vacuum.

Sec. 108.11.2. Specifications Other Than Chapter Sixth. Wherever the use of a mechanical device for the prevention of back-flow and/or back-siphonage is required under and pursuant to the provisions of this Article (other than those set forth in said Chapter Sixth hereof) and/or is permitted by said Department under and pursuant thereto, said mechanical device shall be of a type approved by said Department and shall possess all the operating functions hereinabove prescribed in Sec. 108.11.1; provided however, that any such mechanical device, so used hereunder, may relieve the "excess" pressure hereinabove referred to in Sec. 108.11.1, Sub-Paragraph (4) equal to, and/or in excess of, twenty (20) pounds per square inch under a "check valve leak" condition of one (1) gallon per minute.

Sec. 108.12. Street Distribution System—Pressure Variation

The street distribution system shall be so designed that: (1) there shall be a minimum hourly pressure variation not greater than twenty (20) pounds per square inch; and (2) the pressure variation at any

point in such distribution system shall not, for more than a minute, exceed, by more than ten (10) pounds per square inch, the mean daily pressure.

Sec. 108.13. Shut-Off Valves in Street Lines

Shut-off valves in street lines and building piping systems shall be so located that drainage of such lines and/or systems will not cause the back-flow and/or back-siphonage of, and/or in, services and/or fixtures. Such conditions shall be prevented and avoided by: (1) shutting the valve controlling pressure; (2) opening a fire hydrant or an air inlet valve at the highest point in the line or system to be drained; and (3) opening the drain for a slow drainage.

Sec. 108.14. Valve and Vacuum Breaker on Distribution Lines

An approved valve and vacuum breaker (of the type used to admit air) shall be installed on, and in, all large distribution lines (including those of a four (4) inches in diameter and larger), one of said fixtures to be located at least every one thousand (1,000) feet horizontally and/or provided for each fifteen (15) feet difference in elevation. Such an air inlet shall be placed on the lower side of a valve so that, when the valve is manually closed, said inlet shall be located on the upper end of the closed system. Such air valves shall be so located as to take in only safe and clean air.

Contemplated Revision of the Treasury Drinking Water Standards

THE requirements for drinking (and culinary) water provided by common carriers for the use of passengers carried in interstate traffic, commonly known as the "Treasury Department Drinking Water Standards," were last revised in 1925, and published in the Public Health Reports of April 10th of that year. Since that time many improvements in water supply practice have been adopted with resulting increased uniformity of quality and safety to the consumer. The revision of the standards to conform more closely to current requirements for water supplies of attainable safety and potability is accordingly in order.

To carry out such a revision the Surgeon General has appointed a special Advisory Committee composed of representatives of various Federal organizations and scientific associations and several members at large. A smaller sub-committee of Public Health Service officers has been designated to prepare tentative suggestions for changes in the present standards which will be submitted for the consideration of the advisory committee.

The membership of the advisory committee, together with the name of the organization which each represents, is as follows:

American Chemical Society:
A. M. BUSWELL, Chief, State Water Survey Div., Urbana, Ill.

American Public Health Association:
ABEL WOLMAN, Prof. San. Eng., Johns Hopkins Univ., Baltimore, Md.

American Society of Civil Engineers:
ARTHUR E. GORMAN, Bureau of Engineering, Dept. Public Works, Chicago, Ill.

American Water Works Association:
CHARLES R. COX, Chief, Bur. Water Supply, State Dept. Health, Albany, N. Y.

Society of American Bacteriologists:
A. C. HUNTER, Principal Bacteriologist, Food and Drug Admin., Federal Security Agency, Washington, D. C.

Conference of State Sanitary Engineers:
ARTHUR D. WESTON, Dir. and Ch. Eng., Div. San. Eng., State Dept. Health, Boston, Mass.

An announcement of the membership of the Advisory Committee appointed to revise the Treasury Department Drinking Water Standards, made by J. K. Hoskins, Secretary of the Advisory Committee, on February 27, 1941.

Food and Drug Administration:
J. W. SALE, Sr. Chemist, Food Div., Federal Security Agency, Washington, D. C.

U. S. Geological Survey:
W. D. COLLINS, Chemist in Charge, Washington, D. C.

Association of American Railroads:
R. C. BARDWELL, Supt., Water Supply, Chesapeake and Ohio Ry., Richmond, Va.

Member-at-Large:
R. F. GOUDEY, San. Eng., Bur. Water Works and Supply, Los Angeles, Calif.

Member-at-Large:
R. E. BUCHANAN, Director, Agr. Expt. Sta., Iowa State College, Ames, Iowa

Member-at-Large:
HERMAN G. BAITY, Prof. San. Eng., Univ. North Carolina, Chapel Hill, N. C.

United States Public Health Service:

Chairman:

JOSEPH W. MOUNTIN, Asst. Surgeon General, Domestic Quarantine Div., Washington, D. C.

Secretary:

J. K. HOSKINS, Chief, Sanitation Sec., Domestic Quarantine Div., Washington, D. C.

The sub-committee, officers of the Public Health Service, consists of the following members:

H. W. STREETER, Sr. San. Eng., Stream Pollution Investigations, Cincinnati, Ohio

C. C. RUCHHOFT, Principal Chemist, Stream Pollution Investigations, Cincinnati, Ohio

C. T. BUTTERFIELD, Principal Bacteriologist, Stream Pollution Investigations, Cincinnati, Ohio

LAWRENCE T. FAIRHALL, Principal Industrial Toxicologist, National Inst. Health, Bethesda, Md.

R. E. TARBETT, Sr. San. Eng., Domestic Quarantine Div., Washington, D. C.

Secretary:

J. K. HOSKINS, Sr. San. Eng., Chief, Sanitation Sec., Domestic Quarantine Div., Washington, D. C.